Draft Ocean Discharge Criteria Evaluation for the General NPDES Permit for Offshore Seafood Processing Discharge in Federal Waters off the Washington and Oregon Coast

Permit No. WAG520000

Prepared for

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August 2015

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ACRONYMS

BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CCE	California Current Large Marine Ecosystem
CFR	Code of Federal Regulations
COLREGs	International Regulations for Preventing Collisions at Sea 1972
CPS	Coastal Pelagic Species
CWA	Clean Water Act
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
DPS	Distict Population Segment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FDA	Food and Drug Adminstration
fm	fathom
FMP	Fishery Management Plan
FR	Federal Register
FWPCA	Federal Water Pollution Control Act
H&G	Headed and gutted (fish)
HAB	harmful algal bloom
HAPC	Habitat Area of Particular Concern
HMS	Highly Migratory Species
IPHC	International Pacific Halibut Commission
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MSD	Marine Sanitation Device
mt	metric ton (1000 kg)
nm	nautical miles
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
NWR	National Wildlife Refuge
ODCE	Ocean Discharge Criteria Evaluation
PCBs	polycholorobiphenyls
PCS	Permit Compliance System
PFMC	Pacific Fishery Management Council
PSP	Paralytic Shellfish Poisoning
SAFE	Stock Assessment and Fishery Evaluation
TSS	Total Suspended Solids
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USEPA	United States Environmental Protection Agency

WASP5	Water Quality Analysis Program Version 5.10
ZOD	Zone of Deposition

SECTION 1.0
INTRODUCTION

1.1 PURPOSE OF EVALUATION

The U.S. Environmental Protection Agency (EPA) intends to issue a National Pollutant Discharge Elimination System (NPDES) General Permit for Offshore Seafood Processors discharging off the coast of Washington and Oregon, subsequently referred to as "Draft Permit". Section 403(c) of the Clean Water Act (CWA) requires that NPDES permits for such ocean discharges be issued in compliance with EPA's *Ocean Discharge Criteria* (40 CFR 125, Subpart M) for preventing unreasonable degradation of ocean waters. The purpose of this Ocean Discharge Criteria Evaluation (ODCE) is to identify pertinent information and concerns relative to the *Ocean Discharge Criteria* and discharges from vessel-based seafood processing facilities which discharge at least 3.0 nautical miles (nm) seaward of the baseline or, if there is no baseline, the line of ordinary low water along the portion of the coast that is in direct contact with the open sea.

EPA's *Ocean Discharge Criteria* set forth specific provisions for determining whether a discharge would cause unreasonable degradation of the marine environment. If it is determined that unreasonable degradation would occur, the permit will not be issued. "Unreasonable degradation" is defined (40 CFR 125.12[e]) as follows:

1. Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities
2. Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms
3. Loss of aesthetic, recreational, scientific, or economic values, which are unreasonable in relation to the benefit derived from the discharge

This determination is to be made based on consideration of the following 10 criteria (40 CFR 125.122):

1. The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged;
2. The potential transport of such pollutants by biological, physical or chemical processes;
3. The composition and vulnerability of the biological communities that may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act (ESA), or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain;
4. The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism;
5. The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs;
6. The potential impacts on human health through direct and indirect pathways;

7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing;
8. Any applicable requirements of an approved Coastal Zone Management Plan;
9. Such other factors relating to the effects of the discharge as may be appropriate;
10. Marine water quality criteria developed pursuant to CWA Section 304(a)(1).

If the Regional Administrator determines that the discharge will not cause unreasonable degradation to the marine environment, a NPDES permit may be issued. If the Regional Administrator has insufficient information to determine, prior to permit issuance that there will be no unreasonable degradation to the marine environment, an NPDES permit will not be issued unless the Regional Administrator, on the basis of the best available information, determines that all the following are true:

1. Such discharge will not cause irreparable harm to the marine environment during the period in which monitoring will take place, and
2. There are no reasonable alternatives to the onsite disposal of these materials, and,
3. The discharge will be in compliance with certain specified permit conditions (40 CFR 125.123(d)).

1.2 SCOPE OF EVALUATION

Issuance of the Draft Permit would authorize discharges from facilities engaged in seafood processing within federal waters only. All discharges covered under the Draft Permit would be vessel-based.

This document relies on information provided in the ODCE drafted in 2008 for offshore seafood processors discharging off the coast of Alaska (ADEC, 2008), the existing Alaska NPDES general permit, the NPDES fact sheet for the offshore seafood processor discharging off the coasts of Washington and Oregon, and a literature review. The Draft Permit is fairly similar to the Alaska offshore seafood processors general permit. For more detailed information concerning certain topics, where appropriate, this document refers the reader to some of these publications.

1.2.1 Area of Coverage of the Draft Permit and Applicability of this ODCE

This document evaluates the impacts of waste discharges proposed to be covered under the Draft Permit for vessel-based seafood processing facilities discharging offshore of the States of Oregon and Washington pursuant to Section 403(c) of the CWA. The Draft Permit will address discharges from operators of offshore vessels, operating and discharging “seafood processing waste” in federal waters of the United States, seaward of the states of Washington and Oregon, greater than 3 nm from shore, engaged in the processing of fresh or frozen seafood products or the processing of mince, surimi, oil, or meal.

1.2.2 Excluded Areas of the Draft Permit

The EPA proposes to exclude the following areas from authorization under the Draft Permit:

1. Any waters inland from the west coasts of Washington and Oregon, including but not limited to, the Strait of Juan de Fuca and the Salish Sea,

2. Any waters under the jurisdiction of Canada,

3. Any waters south of the Oregon / California border (42°00" N lat),

4. Any state waters, and

1.2.3 Authorized Discharges

The Draft Permit identifies a number of discharges associated with seafood processing facilities. The Draft Permit proposes that the following discharges be authorized:

1. Seafood process wastewater and wastes, including the waste fluids, heads, organs, flesh, fins, bones, skin, chitinous shells, and stickwater produced by the conversion of aquatic animals from a raw form to a marketable form.
2. Wash-down water, including process disinfectants added to wash-down water used to control microbial contamination of seafood processing equipment and containers, and to sanitize seafood processing areas.
3. Sanitary and domestic wastes and gray wastewater associated with the kitchen, shower, sink, and toilet effluents.
4. Other wastewaters generated in the seafood processing operation, including, seafood catch transfer water, live tank water, refrigerated seawater, cooking water, boiler water, gray water, cooling water, refrigeration condensate, freshwater pressure relief water, clean-up water, and scrubber water.

1.2.4 Unauthorized Dicharges

1. The Permit does not authorize the discharge of any waste or waste streams, including spills, garbage, equipment, and other unintentional or non-routine discharges of pollutants, that are not part of the normal operation of the facility as disclosed in the NOI to be covered, and specifically authorized by this Permit.

2. This Permit does not authorize the discharge of pollutants from any shorebased facilities, nor the discharge of any pollutants from vessels transporting material for the purposes of dumping materials into ocean waters.

3. This general NPDES permit does not authorize any discharges from facilities that (1) have not submitted a Notice of Intent and received written authorization to discharge under this Permit from EPA or (2) have not been notified in writing by EPA that they are covered under this Permit as provided for in the 40 CFR 122.28(b)(2)(vi).

4. The discharge of petroleum (e.g., diesel, kerosene, and gasoline) or hazardous substances into or upon the navigable waters of the U.S., adjoining shorelines, into or upon the waters of the contiguous zone which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the U.S., is prohibited under 33 U.S.C. § 1321(b)(3).

1.3 OVERVIEW OF REPORT

The ODCE focuses on the sources, fate, and potential effects of seafood processing discharges on various groups of aquatic life. The types and nature of the discharges are detailed in Section 2.0 including anticipated volumes of wastes, proximate chemical composition, and concentrations. The fate, transport, and persistence of the wastes are examined in Section 3.0, which presents numerical analyses including an upper-bound estimate of waste accumulation on the seafloor, an upper-bound estimate of Total Suspended Solids (TSS) concentrations in ocean waters in the vicinity of the discharge, and an estimate of critical TSS concentrations that would reduce the depth of the compensation point for photosynthetic activity by more than 10%.

Before discussing potential biological and ecological effects, an overview of aquatic communities and important species is presented in Section 4.0. Chemicals that are considered bioaccumulative or persistent are not generally used in the process. Potential seafood discharge impacts on marine life are presented in Section 5.0. The potential for the discharges to adversely impact threatened and endangered species as identified under the ESA is discussed in Section 6.0. Particularly important uses and plans for the Draft Permit area, including commercial and recreational harvests, special aquatic sites, and coastal management plans are discussed in Sections 7.0 and 8.0. Section 9.0 discusses compliance of expected seafood discharges with federal and state water quality criteria. Section 10 summarizes the findings of this report.

SECTION 2.0

COMPOSITION AND QUANTITIES OF MATERIALS DISCHARGED

2.1 HYDROGRAPHY

The Draft Permit, applies to facilities operating in federal waters off the coasts of Washington and Oregon, including discharges within ocean waters, the contiguous zone, and the United States Exclusive Economic Zone (EEZ), in all extending from 3 to 200 nm offshore.

2.1.1 Seasonality and Location of known Seafood Processing Operations

Discharge volumes from individual processing vessels vary significantly. Because this is a new permit, the current extent of seafood processing, in the proposed area, is not completely known. One fishery that will be covered by the Draft Permit is the Pacific whiting fishery. For 2011 the estimated discharge of wastes from at-sea whiting processors, in the areas covered by the Draft Permit, is between 120-188 million pounds. Offshore seafood processing facilities discharge throughout federal waters along the States of Washington and Oregon. Processing activities can occur any time throughout the year, with peaks in activity occurring in late spring and late summer through fall, for the Pacific whiting fishery.

2.1.2 Waste Production

There are two types of offshore processors; catcher-processors and motherships. Catcher-processors are composed of vessels that harvest and process seafood. Motherships do not harvest any seafood, they instead have a number of catcher vessels that harvest and deliver seafood for the mothership to process. Each mothership is typically serviced by three to four catcher vessels.

The location of processing varies continually. Both the catcher-processors and the motherships are in continual motion while processing, with speeds usually ranging from 3 to 18 knots (3.5 to 20.7 mph) at all times. All processing occurs within federal waters.

2.1.3 Example Seafood Processing Techniques

Most offshore seafood processing will result in one or more the following recoverable products:

- H&G blocks (headed and gutted fish with tails removed)
- Fillet blocks
- Minced blocks
- Surimi blocks
- Fishmeal
- Fish oil

All offshore processing vessels vary in their production line(s), processing steps, capacity, finished products, etc. The following narrative provides a generalized description of how processing works aboard an offshore processor.

Sea water is used to move fish and waste via flumes to grinders and discharge chutes and secondarily for clean-up and sanitation.

Freshwater is either generated onboard or acquired from a shore-based source. It is then used in the surimi making process, for employee housing and sanitation needs.

The production process begins when fish is hauled on board. The fish are emptied into a holding bin. From the holding bin the fish are transferred onto a sorting belt where the catch is sorted by primary species. All the fish is weighed as it travels along the belt. The prohibited species are sent to the observer, and the rest of the bycatch, that is not processed, is returned to the sea via the discard chute. The remaining catch is sent to the starting point of one of the processing lines.

The fish is then sorted by size for processing on alternative processing lines. Each line consists of a machine that will head, gut, debone and skin the fish. If the desired product is H&G fish only the first two processes are performed. Otherwise the end product is boned and skinned fillets. The belly flap trim is transferred to a mince processing line, if the vessel has that capability onboard. On vessels that have a fishmeal processing line, the head, guts and skin are transferred there for further processing. On vessels where no fishmeal processing line exists, these materials are ground and discharged.

Fillets are transferred by conveyor to the candling table where they are checked for defects and parasites. Those fillets that meet quality standards are packed in a plastic basket, check weighted and transferred into a freezer frame with a box liner. The freezer frame is transferred to the plate freezers and frozen. The frozen blocks are packed in master cartons, strapped and transferred to a storage hold. Those fillets that do not meet quality standards as fillets are transferred either to the mince operation if the quality meets mince standards, to fishmeal if they do not meet mince standards, or are ground and discharged if no further processing is available.

The backbones go to the surimi processing line to extract as much flesh from the bones as possible. This process produces a paste that is extruded into plastic bags and then is frozen in a manner that is similar to the fillets. After the flesh is extracted from the bones, they are transferred to the fishmeal processing line, if available. If the fishmeal line cannot handle all the fish bones due to the volume of the catch, the excess bones are transferred to the discharge sump, ground and discharged.

The only other processing-related waste that is discharged is the wash down water including fish products that end up inadvertently on the vessel floor. This waste is ground and discharged.

Fish processed as H&G recover approximately 50 percent of raw input. Fish processed into fillets have recovery rates ranging from 25 to 50 percent. Surimi production, a minced flesh product, recovers from 7 to 22 percent of the whole fish depending on the primary product of the processing effort. Reported estimates for recovery as fishmeal range from 3 to 7 percent, and a recovery estimate has been reported for fish oil of one percent of raw input.

2.2 SEAFOOD PROCESSING WASTE CHARACTERISTICS

Discharges from seafood processing facilities may be classified into solid (particulate) and dissolved (soluble) wastes. Two categories of solid waste discharges are generated by seafood processing: ground and unground waste materials. The ground fish waste stream consists of processed raw fish and shellfish include heads, skin, scales, viscera, tail fins, shells discarded during cleaning and butchering operations, damaged fish, and unusable fish. Unground solid waste is comprised of sea debris, prohibited species fish and bycatch species that are neither processed nor retained. Dissolved wastes include solubilized organic matter and nutrients leached from fish tissues after processing. The specific chemical composition of these wastes depends on the amount of protein, fat, bone, chitin, and connective tissue present. The character and quantity of solid and liquid seafood processing wastes is assessed below.

2.2.1 Solid Wastes from Seafood Processing

Seafood waste streams generally consist of the material that cannot be processed by the onboard processing plant and is piped or conveyed to the collecting sumps on the processing deck where it is ground and pumped overboard. It is assumed that the ground fish waste has a low impact on the receiving water due to the wide dispersion of waste over a large area and volume of water, as well as the biodegradable nature of the waste.

Unground solid waste is comprised of sea debris, prohibited species fish and by-catch that is neither processed nor retained. All these are discharged directly from the vessel. This category of discharge material represents an extremely small fraction of the solid waste.

The quantity and chemical composition of the solid waste discharged by seafood processing facilities determines the effects that the discharges may have on the aquatic environment. As noted above, seafood processing solid waste consists of both organic and inorganic material including protein, fat (oil and grease), and ash (inorganic component of fish waste). Tables 2.1 and 2.2 present details on the measured contents and theoretical composition of whitefish wastes. Most of the solid fish waste contains at least 75 percent water. The percentages of protein were similar for most types of fish waste sampled (approximately 10-15 percent wet weight). The percentage of fat was generally less than 3 percent, although viscera from pollock (a similar fish to Pacific whiting) had a much higher fat content (40 percent of wet weight). The percentage of ash, which represents the inorganic component of fish waste, was generally less than 5 percent wet weight. The percent of carbon, nitrogen, phosphorus, and sulfur based on wet weights is estimated at 16.7, 2.9, 0.3 and 0.3 percent respectively. Less discrete composition analyses have been performed and reported for whiting (whole fish, fillet, fillet waste) (Nelson et al., 1985). The results of these analyses are consistent with the information presented in Tables 2.1 and 2.2.

Table 2.1 Approximate Composition (Percent) of Whitefish Fillet and Surimi Wastes

Type	Sample	n[1]	Moisture	Protein	Fat	Ash	Source
Pollock	Machine fillet (winter)	4	81.3	11.3	3.0	3.6	Crapo et al., 1988
Pollock	Machine fillet (spawning)	4	82.0	12.5	1.9	3.7	Crapo et al., 1988
Pollock	Hand fillet	n/a	74.8	13.8	8.9	2.7	Babbitt, 1982
Pollock	Heads	n/a	81.1	13.6	1.4	4.9	Babbitt, 1982
Pollock	Viscera	n/a	45.0	8.2	40.1	0.8	Babbitt, 1982
Pollock	Frame	n/a	80.4	15.9	0.7	3.3	Babbitt, 1982
Pollock	Skin	n/a	81.8	18.0	0.3	0.9	Babbitt, 1982
Pollock	Bloodwater	3	98.5	0.9	0.2	0.3	Crapo et al., 1988
Surimi	Filet waste	3	81.3	11.3	3.0	3.6	Crapo et al., 1988

Type	Sample	n[1]	Moisture	Protein	Fat	Ash	Source
Surimi	Bloodwater	3	97.9	1.3	0.4	0.3	Crapo et al., 1988
Surimi	Deboner waste	3	86.1	10.7	0.8	0.7	Crapo et al., 1988
Surimi	Refiner waste	3	86.4	12.1	0.7	0.4	Crapo et al., 1988
Surimi	Rotary screen wastewater	3	98.8	0.8	0.2	0.2	Crapo et al., 1988

[1]n = number of samples analyzed

Table 2.2 Theoretical Composition of Seafood Waste (excerpted from USEPA, 2008)

Constituent	Percent Wet Weight	Approximate [a] Density (g/cm^3)	Percent Dry Weight
Water	75	1.0	-
Protein	7	1.5	60
Fat/Carbohydrates	15	0.9	28
Bone/Chitin	3	3.0	12
Total Estimated Wet Weight Density	-	1.13	-
Carbon	16.7	-	50.0[b]
Nitrogen	2.9 [c]	-	8.8 [c]
Phosphorus	0.27 [c]	-	0.8 [c]
Sulfur	0.27 [c]	-	0.8 [c]

[a] Typical values listed in the Handbook of Chemistry and Physics (Weast, 1982).
[b] Typical dry weight carbon (C) content of organic matter used.
[c] Estimated concentration of nitrogen (N) and phosphorus (P) based on the Redfield ratio of C:N:P (106:16:1) in organic matter (Redfield, 1958; Redfield et al., 1963).
Ratio of sulfur to phosphorus assumed to be 1:1.

2.2.2 Bottom Accumulations of Solid Waste

Accumulations of waste material on the bottom of the receiving water occur when the rates of deposition at a specific location exceed the rates at which material can be assimilated by the community that feeds at that location and/or the rate at which the material is likely to be dispersed by hydrodynamic forces. The likelihood of bottom accumulations due to offshore seafood processing is very low for two reasons:

1. All dischargers are in constant motion. Reported vessel speeds are maintained between 3 and 18 knots (3.3 and 20.7 mph) at all times.
2. Water depth is usually a minimum of 35 fathoms (fm) (210 feet) in reported seafood processing areas. The combination of wind, tide and water depth greatly increases mixing and dispersion of discharges. This minimizes concentrated oxygen consumption, sedimentation of solids, and potential impact on sea life and water quality.

2.2.3 Dissolved Wastes from Seafood Processing

Current effluent data on discharges from offshore seafood processors in the action area are not available. Table 2.3 presents effluent characteristics of dissolved wastes from shorebased groundfish dischargers operating in Alaska in 1992 and 1993. Discharge characteristics in offshore waters are expected to be similar to this shorebased data. Discharge characteristics are not expected to have changed significantly since these data were collected. Caution should be used when comparing the median and maximum values for each effluent type because the data points, even if equal in number, may be from different facilities or time periods.

Table 2.3 Effluent Data for Alaskan Shore-based Seafood Processors Discharging under Individual Permits in 1992 and 1993[2]

Product[2]		TSS mg/L		Oil & Grease (mg/L)		BOD (mg/L)	
		Monthly Avg.	Daily Max.	Monthly Avg.	Daily Max.	Monthly Avg.	Daily Max.
Bottomfish	Median	105	150	73	91	n/a	n/a
	n	120	124	101	106	n/a	n/a
	Minimum	10	6.0	2.8	4.5	n/a	n/a
	Maximum	4,553	3,324	1,621	1,486	n/a	n/a
Meal	Median	88	142	28	44	80	120
	n	18	18	18	18	15	15
	Minimum	16	24	1.4	1.4	36	36
	Maximum	1,330	1,949	153	284	13,356	39,750
Stickwater	Median	4,900	9,540	2.1	5.6	7,600	7,600
	n	53	53	25	25	47	47
	Minimum	9	23	0.2	0.2	1.5	2
	Maximum	84,000	110,000	91,139	203,800	148,950	432,000
Surimi	Median	1,079	1,366	208	257	2,323	1,845
	n	25	25	25	25	6	6
	Minimum	24	33	8	17	286	286
	Maximum	6,209	7,808	282,400	295,200	7,328	7,750

n/a = not available

[1] Obtained from Discharge Monitoring Reports (DMRs) submitted to EPA's Permit Compliance System (PCS)

[2] Product Classifications are as follows:

Bottomfish = Bottomfish (pollock, cod, sablefish, etc.) sections
Meal = Fishmeal
Stickwater = Stickwater from fish meal operations
Surimi = Surimi production from pollock

In addition to oil and grease, Biochemical Oxygen Demand (BOD), and TSS, other contaminants can be present in effluent from seafood processing facilities. The dissolved wastes may include disinfectants used to maintain sanitary conditions in compliance with requirements for the production of food for human consumption. The following sections provide greater detail on stickwater, surimi wastewater, wash-down water, sanitary wastewater and other wastewaters.

Stickwater

Stickwater is the mixture of water, oil, proteins, fats and ash separated from the press liquor generated during the production of fish meal. After decanting to remove oil, this stream is a dilute solution of insoluble fines, very fine denatured solubles, and water soluble connective tissue. A small amount of fish oil is present as an emulsion with the protein. The impact of this stream is low due to dilute concentration, fine particle size and inability of the oil fraction to coalesce. Note that the effluent data, summarized above in Table 2.3 shows that stickwater has one of the highest median concentrations for TSS and BOD compared to other wastewaters.

Surimi Wastewater

Surimi production is a washed minced fish product. The manufacturing process includes gutting, heading, deboning and filleting followed by mincing and washing. Surimi wastewater is relatively high in TSS and BOD and had the highest median and maximum values for oil and grease compared to other liquid wastes as shown in Table 2.3.

Wash-down Water

Wash-down water is used to remove wastes and maintain sanitary standards during processing operations. In addition to the organic materials, these discharges may include disinfectants that could contain chlorine-, iodine-, or ammonium chloride-based solutions. These wastes are generally low in volume.

Sanitary Wastewater

Sanitary waste is human body waste discharged from toilets and urinals. The pollutants associated with this discharge include TSS, BOD, bacteria, and residual chlorine. All vessels must employ properly functioning Type I or Type II Marine Sanitation Devices (MSDs).

Other Wastewaters

Other wastewaters include other liquid wastes generated during seafood processing operations. These low-volume wastes include catch transfer water, live tank water, refrigerated seawater, cooking water, boiler water, cooling water, refrigerator condensate, pressure relief water, clean-up water and scrubber water. Wastewaters not having contact with seafood are not required to be discharged through the seafood process waste-handling system. These wastes would not be expected to contain concentrations of contaminants that would be detrimental to marine organisms.

2.2.4 Summary

Offshore seafood processing facilities are located throughout federal Waters offshore of Washington and Oregon. Processing activities occur seasonally with peaks in late spring and late summer through fall. Discharge volumes from individual facilities range widely.

Seafood processors discharge waste in two forms, solid and dissolved. Solid wastes consist of biological waste materials not used in final products and include fish heads, offal, scales, bones and shells. Dissolved wastes are liquid based and consist of the dissolved and suspended materials that pass through processing operations. The vast majority of the dissolved wastes contain proteins, fats, nutrients, and ash. Small components of the effluent stream, such as wash-down water, may include disinfectants that could be toxic to marine life. Data on the volume of dissolved wastes discharged by seafood processors is not readily available.

Most wastes discharged from seafood processing facilities are not known to persist in the environment over long periods of time. On a chemical basis, the composition of these organic wastes do not include constituents that would normally be suspected of accumulating or persisting in the environment. Likewise, the dissolved wastes could contribute to localized and short term changes in water chemistry (reduced dissolved oxygen) or reduced light transmission; however, the constituents are unlikely to accumulate or persist in the receiving waters, with vessels in constant motion and high wind and tidal activities.

Criterion #1 of the Ocean Discharge Criteria assesses “the quantities composition, and potential for bioaccumulation or persistence of pollutants in the discharge.” Seafood processing generates a significant volume of wastes, consisting mostly of organic material resulting from butchering and processing operations. The accumulation of toxic contaminants as a result of discharges under the Draft Permit is unlikely.

SECTION 3.0

TRANSPORT, PERSISTENCE, AND FATE OF MATERIALS DISCHARGED

Seafood processing results in the discharge of wastewater consisting of solid and liquid wastes. These wastes consist primarily of dissolved and particulate organic matter and nutrients. Depending on the type and amount of waste discharged, and the physical, biological, and chemical characteristics of the receiving water, wastewater discharges from seafood processors have the potential to impair marine waters. These potential adverse effects on the quality of marine waters include reduction in water column dissolved oxygen due to the decay of particulate and soluble waste organic matter, the release of toxic levels of sulfide and ammonia from decaying waste, nutrient enrichment (eutrophication) and stimulation of phytoplankton growth and alteration of the phytoplankton community, and the accumulation of buoyant waste solids and fish oils on the water surface.

Seafood waste discharges also have the potential to accumulate on the receiving water bottom in the vicinity of the discharge. The accumulation and decay of seafood waste solids can result in the smothering of benthic marine organisms, and the release of carbon dioxide, methane, ammonia, soluble phosphorus, and hydrogen sulfide. The decay of the waste accumulation and the release of microbial decomposition by-products (e.g., sulfide and methane) also exerts a demand on the dissolved oxygen content of the overlying water column and within the sediments. These potential impacts on marine organisms are discussed in detail in Section 5.0.

The following section describes modeling of the transport, fate, and persistence of discharges from seafood processing facilities in the offshore waters of Washington and Oregon to evaluate the potential impacts of these discharges.

3.1 CHARACTERISTICS OF DISCHARGES AND RECEIVING WATERS

3.1.1 Characteristics of Discharges

Seafood processing waste from motherships and catcher-processor vessels are discharged by pump, and can, therefore, be characterized in terms of mass and volume.

3.1.1.1 Potential environmental impacts

Seafood processing generates a substantial quantity of waste, primarily organic material from butchering and processing operations. Processing wastewater contains dissolved and particulate organic matter and nutrients that have the potential to negatively impact water quality. Constituents of particular concern include particulate matter, BOD, oil and grease, bacteria, and pH. Solids in the discharges have the potential to accumulate on the seafloor, impacting benthic organisms. Particulate matter also has the potential to impact phytoplankton growth in the water column, by reducing the compensation point for photosynthetic activity. Decay of organic matter reduces dissolved oxygen in the water column, affecting aquatic organisms.

Wash-down water, sanitary wastewater and other wastewaters are also generated and covered under the Draft Permit.

3.1.1.2 Mass estimates

Communications from Pacific whiting industry representatives have presented current estimates of daily processing ranging from 700,000 to 1,600,00 lb/day (350 to 800 mt/day). Recovery fraction (fraction of catch recovered as product) is reported to range from 26.6% to 53%, so between 47% and 73.4% of the mass processed is discharged into the ocean.

3.1.1.3 Volume estimates

The discharge of mass through pumps is associated with a discharge volume. Processors report operating discharges ranging from 1541 – 9400 gpm (350 to 2,135 m^3/hour).

3.1.2 Characteristics of Receiving Waters

The receiving waters for offshore seafood processing discharges are restricted to hydrodynamically energetic waters, located at least three nm offshore of Washington and Oregon and usually to a depth of at least 210 feet. Several receiving water characteristics were identified that may influence the fate and transport of seafood process discharges. However, as indicated below, the conservative assumptions of the analyses herein did not require their consideration.

- Depth. Results from the analyses in this document are independent of water column depth; the approaches used to estimate bottom accumulation and discharge dilution are simple and conservative and will result in the same estimate regardless of water column depth.
- Temperature. Temperature is not considered in the analyses.
- Stratification. Stratification is not a factor in the analyses.
- Circulation. Circulation is not a factor in the analyses.

3.1.3 Important Processes

Certain key processes were identified beforehand for consideration in this evaluation

- Settling. The gravity-driven deposition of discharged material through the water column to the ocean bottom.
- Dispersion. Spreading of discharged material laterally in the water column induced by hydrodynamic activity.
- Decay/loss. Removal of material from the water column by consumption or transformation.

The analyses performed in this evaluation did not depend on dispersion, uptake or decay (thereby providing very conservative results), while the rate of settling could cause light transmission impacts in the near field.

3.2 NUMERICAL ANALYSIS TO ASSESS POTENTIAL IMPACTS

This section describes the analyses undertaken to assess potential impacts from the discharge of offshore seafood processing wastes on offshore waters. Two analyses were performed:

- An upper-bound estimate of waste accumulation on the seafloor from offshore seafood processing discharges.
- An upper-bound estimate of TSS concentrations in ocean waters in the vicinity of an operating processing vessel. This analysis also estimates the minimum dilution factor for volumetric discharges.

Descriptions of both analysis, including governing equations, model inputs, and results, are presented below. The analyses were developed to provide extremely conservative estimates of upper bounds on the dependent variables.

3.2.1 Seafloor Waste Accumulation

An upper-bound estimate of waste accumulation on the seafloor was arrived at by distributing the maximum discharged mass as estimated from industry-supplied data over a seafloor area directly below the path of the discharging offshore seafood processor. The analysis assumes that all discharged mass is distributed equally across a rectangular area of water whose width is the beam of the discharging ship and whose length corresponds to the distance traveled by the ship during the period of discharge.

Daily discharge = (daily fish mass processed) * (1 – recovery percentage)
Deposited mass / unit area = (Daily discharge) / (Path area)
Depth of accumulation = (Deposited mass / unit area) / density / (1 – porosity)

The analysis is implemented in a Microsoft Excel worksheet (Figure 3.1)

Ship Speed	3	knots	min ship speed
Ship Speed	5,556	m/hr	ship speed (knots)x1852 (meter/hr)/knot
Ship beam	15	m/hr	beam of smallest ship
Distance Travelled	133,344	m/day	ship speed x 24 hrs
Daily Fish Processed	800	mt	max reported
Daily Fish Processed	800,000	kg	daily fish processed (mt) x 1000 (kg/mt)
Recovery percentage	26.6	%	lowest reported
Daily Discharge	587,200	kg/day	daily fish processed (kg) x(1- recovery percentage)
Fraction settleable	100	%	complete settling
Density of settleable material	1,130	kg/m^3	published
Porosity of settled material	0.95		max of published range
Mass deposited per unit area	0.29	kg/m^2	daily discharge (kg)/(Distance travelled*Ship beam)
Depth of accumulation	0.0052	m	mass deposited per m^2/(density x (1-porosity))
Depth of accumulation	0.52	cm	depth in m x 100 cm/m

Figure 3.1 Spreadsheet Presenting Analysis of Seafloor Waste Accumulation

3.2.1.1 Inputs

The inputs required for the analysis are presented below with an explanations of the values selected:

- **Ship speed** = 3 knots. 3 knots (5556 m/hr) is the lowest speed at which seafood processors in the action area operate; vessels usually travel between 3-18 knots while processing, therefore, this is a **conservative** selection. If the analysis was rerun with a higher speed selected, the path area would increase and result in a lower estimate of depth of accumulation.

- **Ship beam** = 15 m. 15 meters is the beam of the smallest ship described in the narrative description of operations (both catcher-processor vessels and motherships were considered); this is a **conservative** selection in that analysis with a wider beam selected would increase the path area and therefore result in a lower estimate of depth of accumulation.
- **Daily mass of fish processed** = 800 mt. 800 metric tons is the high end of the range of daily processing masses reported by industry representatives; this is a **conservative** selection in that analysis with a lower mass selected would decrease the discharged mass and result in a lower estimate of depth of accumulation.
- **Recovery percentage** = 26.6%. This is the lowest value reported for the percent of mass recovered (mass of product) from processing operations; this is a **conservative** selection in that analysis with a higher recovery percentage selected would decrease the discharged mass and result in a lower estimate of depth of accumulation.
- **Fraction settleable** = 100%. The fraction of discharged waste that actually settles to the bottom could range from 0% to 100%, depending on the nature of the solids and on loss rates due to consumption. As it is assumed not all waste will reach the seafloor, the selection of 100% as settleable is a very **conservative** selection, in that analysis using a lower fraction would decrease the deposited mass and result in a lower estimate of depth of accumulation.
- **Density of settleable material** = 1130 kg/m^3. The density of the material is used to translate deposited mass into a volume, and then a depth. This value is taken from Table 2.2 in the Alaska ODCE (ADEC, 2008).
- **Porosity of deposited material** = 0.95. The porosity of the material is used to translate the volume of deposited material into a depth of accumulation. The value of 0.95 is a **conservative** selection for this input, corresponding to a very loose consistency that is unlikely to impede movement of benthic organisms. This porosity value is the upper value in the reported range of 0.8-0.95 for newly deposited muds in coastal environments (Harris, 2003), indicating a very loose consistency.

3.2.1.2 Assumptions

Additional assumptions embedded in the analysis are as follows:

- **Discharge rate.** The discharge rate is assumed to be constant throughout the 24-hour evaluation period.
- **Near-field mixing and dispersion.** Discharges of materials from a moving ship are generally subject to mixing in the wake. Although the literature suggests that the discharge will be distributed across the wake (Loehr et al, 2006), this analysis limits the spread of the material to a narrow area whose width is the ship's beam. This is a **conservative** assumption in that incorporation of any additional near-field dispersion would result in an increase of the depositional area and a lower estimate of depth of accumulation.
- **Hydrodynamically energetic waters.** Settling of material through hydrodynamically energetic waters likely will be accompanied by dispersion processes that would increase the depositional area for the discharged waste. This analysis assumes no dispersion, which is a **conservative** assumption in that any increase in the depositional are would

result in a lower estimate of depth of accumulation. Discharge into hydrodynamically active waters would be additionally protective of benthic organisms.

- **Loss from decay, consumption, or transformation.** The discharged ground materials may include components that are either chemically reactive or attractive to marine flora and fauna, leading to their removal from the water column. This analysis assumes no such losses, which is a **conservative** assumption in that any accounting for loss would result in a lower mass deposit and a lower estimate of depth of accumulation.
- **Depth of water column.** Depth is not a parameter for the seafloor accumulation analysis. However, the analysis assumes that operations take place at a sufficient depth that bottom disturbance from ship passage is not an issue.

3.2.1.3 Results

As shown in Figure 3.1, the extremely conservative analysis of discharges from a seafood processing vessel moving at three knots estimates that a maximum of about 294 grams (0.65 pounds) of ground waste will be deposited per square meter of bottom. Assuming a conservatively high porosity value of 0.95, translates to a worst case scenario with an average depth of accumulation of 0.5 cm.

3.2.2 TSS Concentration in Receiving Waters

An upper bound on the concentration of TSS in the receiving waters was estimated using a simple dilution factor calculation. The calculation was developed for the determining dilution of wastewater behind a cruise ship (Loehr et al., 2006):

Dilution factor = 4 * (ship width * ship draft * ship speed) / (volume discharge rate)

Daily TSS discharge = (daily mass fish processed) * (fraction waste)

Daily TSS discharge concentration = (Daily TSS discharge) / (pump speed discharged)

Diluted TSS concentration = (Daily TSS discharge concentration) / (Dilution factor)

This analysis is implemented in a Microsoft Excel spreadsheet (Figure 3.2).

	max pump speed	min pump speed		
Ship Speed	3	3	knots	min ship speed
Ship Speed	5,556	5,556	m/hr	ship speed (knots) x 1852 (meter/hr)/knot
Ship Beam	15	15	m	beam or width of smallest ship
Ship Draft	7.5	7.5	m	draft of smallest ship
Daily Fish Processed	800	800	mt	max reported
Daily Fish Processed	800,000	800,000	kg	daily fish processed (mt) x 1000 (kg/mt)
Recovery Percentage	26.6	26.6	%	lowest reported
Daily Discharge	587,200	587,200	kg/day	daily fish processed (kg) x (1- recovery percentage)

Discharge Rate	24,467	24,467	kg/hr	daily discharge (kg/day) / 24 (hr/day)
Hourly Volume Discharged	2,135	300	m^3/hr	max and min pump speed reported
TSS Discharge Concentration	11.46	81.56	kg/m^3	daily discharge (kg/hr) / pump speed (m^3/hr)
TSS Discharge Concentration	11,460	81,556	mg/l	discharge concentration (kg/m^3) x 1000mg/l / (kg/m^3)
Dilution Factor	1,171	8,334		4 x (ship width (m) x ship draft (m) x ship speed (m/hr)) / pump seed (m^3/hr)
Diluted TSS Concentration	9.79	9.79	mg/l	daily TSS discharge concentration (mg/l) / dilution factor

Figure 3.2 Spreadsheet Presenting Analysis of TSS Concentration in Receiving Waters

3.2.2.1 Inputs

The inputs required for the analysis are presented below with explanations of the values selected:

- **Ship beam** = 15 m. 15 meters is the beam of the smallest ship described in the provided narrative description of operations (both catcher-processor vessels and motherships were considered); this is a **conservative** selection in that analysis with a wider beam selected would increase the displaced volume and therefore result in a lower estimate of TSS concentration.
- **Ship draft** = 7.5 m. 7.5 meters is the draft of the smallest ship described in the narrative description of operations (both catcher-processor vessels and motherships were considered); this is a **conservative** selection in that analysis with a deeper draft selected would increase the displaced volume and therefore result in a lower estimate of TSS concentration
- **Ship speed** = 3 knots (5556 m/hr). 3 knots is the lowest speed operators in the action area travel while processing, as the range is usually 3-18; this is a **conservative** selection in that analysis with a higher speed selected would increase the path area and therefore result in a lower estimate of TSS concentration.
- **Daily mass of fish processed** = 800 mt. 800 metric tons is the high end of the range of reported daily processing; this is a **conservative** selection in that analysis with a lower mass would decrease the discharged mass and result in a lower estimate of TSS concentration.
- **Recovery percentage** = 26.6%. This is the lowest value reported for the percent of mass recovered (mass of product) from processing operations; this is a **conservative** selection in that analysis with a higher recovery percentage selected would decrease the discharged ground waste overall and result in a lower estimate of TSS concentration.
- **Pump speed =** 300, 2135 m^3/h. Figure 2 shows the analysis performed at two different assumed rates for pump discharge associated with operations. 2135 m^3/h is the highest possible value ascertainable from provided ship configuration, while 300 m^3/h is the

lowest value reported for pumping during operations. Note that there is no difference in receiving water concentration results, though dilution is markedly different. The receiving water concentration remains the same because the total volume of water displaced by the moving ship and therefore available for dilution of the discharged mass is the same under either pumping rate. The calculated dilution factor corresponds to the fraction of the displaced volume that is made up of water pumped from the ship, and so differs for different pumping rates.

3.2.2.2 Assumptions

- **Discharge rate.** The mass and volume discharge rates are assumed to be constant throughout the 24-hour evaluation period.
- **Hydrodynamically energetic waters.** Discharge of material into hydrodynamically energetic waters likely will be accompanied by dispersion processes that would decrease the receiving water concentration. This analysis assumes no dispersion beyond that induced by the motion of the ship through the water, which is a **conservative** assumption, in that any increase in the dispersion would result in a lower estimate of TSS concentration. Discharge into hydrodynamically active waters would be expected to result in further reductions.
- **Loss from decay, consumption, or transformation.** The discharged materials may include components that are either chemically reactive or attractive to marine flora and fauna, leading to their removal from the water column. This analysis assumes no such losses, which is a **conservative** assumption in that any accounting for loss would result in a lower estimate of TSS concentration.

3.2.2.3 Results

As shown in Figure 3.2, the extremely conservative analysis of discharges from a seafood processing vessel moving at three knots estimates a minimum dilution factor of 1,171:1 for waters discharged from the ship when all pumps are operating at maximum capacity; this dilution factor goes up to 8,334:1 at the low end of reported pump operations. These dilutions translate to a worst case scenario maximum incremental increase in TSS concentration of 9.79 mg/L found in mixed water behind the ship, which should be protective of marine water quality.

SECTION 4.0

COMPOSITION OF BIOLOGICAL COMMUNITIES

Section 4.0 provides an overview of the biological communities found within the Draft Permit action area. The overview will identify key species that are important from an ecological standpoint, along with interspecies relationships, economic considerations, essential environmental requirements, seasonal distribution and abundance, and prominent areas or habitats.

4.1 THE CALIFORNIA CURRENT LARGE MARINE ECOSYSTEM

The United States Pacific Exclusive Economic Zone (EEZ), which encompasses ocean waters from 3 to 200 nm offshore of the continental west coast, is part of the California Current Large Marine Ecosystem (CCE). The CCE extends from Washington State to Baja California in Mexico as shown in Figure 4.1. Its major eastern boundary current, the California Current, is a massive southward flow of water ranging from 50 to 500 kilometers offshore (Mann and Lazier, 1996). The ecosystem is characterized by seasonal upwellings of cold, nutrient-rich water which generate high primary productivity, the growth of the algae that form the base of the marine food chain. The Draft Permit action area, which is off the coasts of Washington and Oregon, is part of the northern subregion of the CCE.

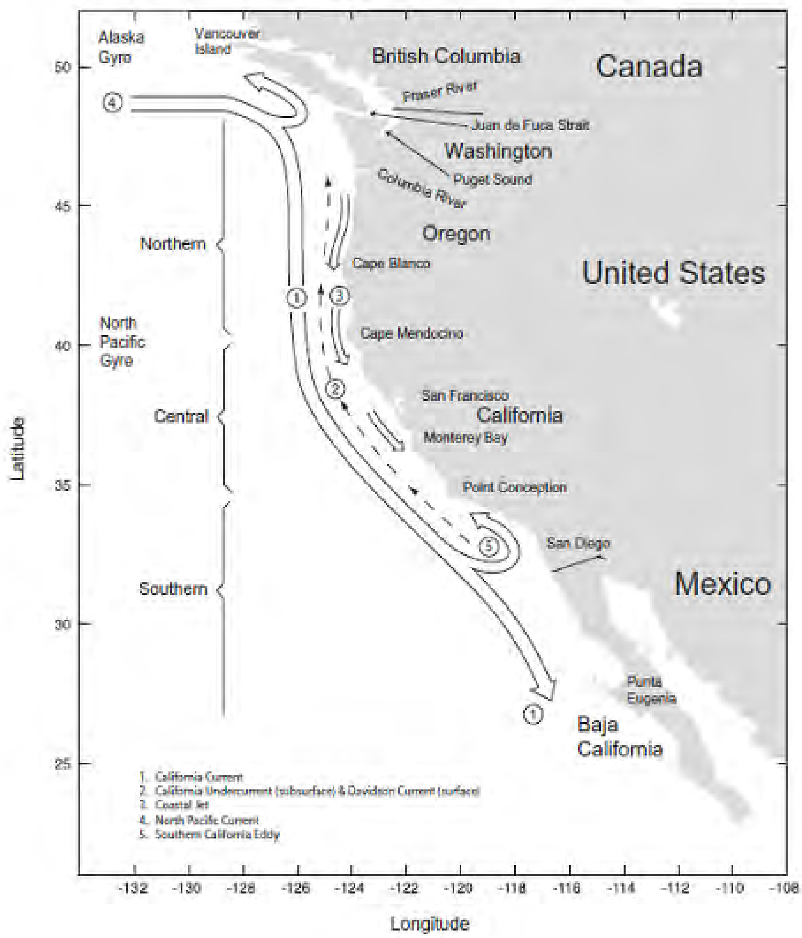

Figure 4.1 Dominant Current Systems off the U.S. West Coast (Source: PFMC, 2012a)

The biological communities to be discussed in this section include plankton, benthic invertebrates, fishes, seabirds, and marine mammals which are found in the CCE. No reptiles are discussed here because all four species of marine turtle that occur within the action area are listed as threatened or endangered; they and other ESA listed species are addressed in Section 6.

4.2 PLANKTON

Planktonic organisms have limited or no ability for self-propulsion and generally are entrained along with water movements; therefore, the distribution, abundance, and seasonal variation of these organisms is strongly influenced by the physical environment. Plankton contain a diverse assemblage of plants (phytoplankton) and animals (zooplankton) that range from a maximum size (equivalent spherical diameter) of a few millimeters to less than 2 microns. These organisms are a vital component of the pelagic plankton community forming the bottom of the food chain for fish, birds, some marine mammals, and other marine organisms. Larval stages of many benthic and fish species are temporary members of the zooplankton community during their early developmental stages (ADEC, 2008).

4.2.1 Primary Producers

Phytoplankton, also known as primary producers, carry out photosynthesis and form the lowest trophic level of the CCE. The most predominant phytoplankton groups within the California Current include the three single-celled phytoplankton classes described below along with large multicellular plants (PFMC, 2012a).

Diatoms, eukaryotic cells with hard silica based shells, are the dominant phytoplankton group in terms of overall productivity and importance as a food resource for higher trophic levels. Diatoms grow rapidly in nearshore regions where upwelling provides cool, nutrient-rich water. In turn, diatoms are grazed by most species of zooplankton, euphausiids, fish larvae and small fish. Occasionally, certain species of diatoms may constitute harmful algal blooms (HABs). Specifically, the diatom *Pseudonitchia multiseries* produces a powerful neurotoxin known as Domoic Acid that can bio-accumulate in the tissues of fish. While diatoms are an important prey for copepods, their protective silica casing prevents them from being readily preyed upon by smaller microzooplankton (PFMC, 2012a).

Dinoflagellates, eukaryotic cells which are often slightly motile, are an important resource in the CCE. Dinoflagellates may outcompete diatoms when silica is limiting since they do not require silica for growth. They are typically preferred by microzooplankton and small crustacean zooplankton as a food source as compared to diatoms, due to their relatively enriched nutrient content and lack of a hard encasement. These organisms often dominate in stratified regions and more commonly form HABs than diatoms (PFMC, 2012a).

Cyanobacteria, prokaryotic cells which account for about 20% of phytoplankton productivity, are more important in offshore regions. Although they do not have a high biomass, they may have high growth rates, providing for rapid nutrient turnover. Cyanobacteria are primarily consumed by unicellular microzooplankton that may be prey for other microzooplankton (PFMC, 2012a).

In northern temperate waters, both phytoplankton productivity and standing stock increase from April to early July with peaks in May and early July, respectively. Phytoplankton biomass is controlled by light, nutrients, and the density structure of the water column (ADEC, 2008).

4.2.2 Secondary Producers

Secondary producers are species that feed either primarily or partially on phytoplankton and include the following groups, ordered roughly from largest to smallest by individual body size:

Small pelagic fish, including baitfish and other forage fish such as sardine, anchovy, and smelts, comprise an integral part of the CCE. They feed nearly exclusively on phytoplankton (typically diatoms), small pelagic crustaceans, and copepods. This group functions as the main pathway of energy flow in the CCE from phytoplankton to larger fish and the young life stages of larger predators. Thus, small pelagic fish form a critical link in the strong, upwelling-driven high production regions of the CCE.

Ichthyoplankton are larval stages of fish including the small pelagics listed above, groundfish, and large pelagic fish such as Pacific hake and jack mackerel. They feed on both phytoplankton and zooplankton and are a key resource for larger fish and other marine organisms. Ichthyoplankton data are limited for the CCE north of Cape Mendocino, CA, but existing studies suggest that off Washington and Oregon, Osmeridae (smelts, typically not identified to the species level) are often highly abundant in the nearshore shelf waters, and tomcod and sandlance are often fairly abundant.

Euphausiids, primarily the species *Euphausia pacifica* and *Thysanoessa trispinosa*, are another key link in the trophic web of the CCE. Also known as krill, they are relatively large crustacean zooplankton. These species primarily eat phytoplankton (diatoms) and small zooplankton, and in turn are the food for many species of fish, birds, and marine mammals. Euphausiids often form large conspicuous schools or swarms that attract larger predators, including whales. Due to their high feeding rates, fast growth rates, and status as a key prey for many species, euphausiids play a critical role in the overall flow of energy through the CCE.

Gelatinous zooplankton are soft-bodied organisms such as jellyfish, pelagic gastropods (primarily pteropods), salps, doliolids and apendicularians. These species take on a variety of forms, from free-floating jellyfish that passively ambush zooplankton and small larval fish prey, to apendicularians that build large gelatinous “houses” used to filter large quantities of the smallest phytoplankton classes from the water column. While gelatinous zooplankton grow at high rates and have high feeding rates, their bodies are mostly composed of water; as a result, they are not typically a good food source for larger organisms, with the exception of certain turtles that specialize in gelatinous prey. One exception is the pteropods, pelagic gastropods that form large gelatinous nets much larger than their body size that are used to capture falling detritus in the water column. Unlike the other taxa in this group, these are known to be an important food source for salmon and possibly other fish species. Typically, gelatinous zooplankton blooms are found offshore in oligotrophic regions (regions that are deficient in plant nutrients and thus generally abundant in dissolved oxygen), although blooms are occasionally predominant nearshore during warmer periods.

Medium crustacean zooplankton includes shrimps, mysids, and other less numerically dominant but important organisms. These species consume both other zooplankton and phytoplankton. Mysids often form swarms in shallow nearshore waters, and may be an important food source for outmigrating smolts.

Copepods and other **small crustacean zooplankton** are often the numerically dominant multi-cellular organism in many areas of the CCE. While they have similar roles to krill, they do not tend to form large dense schools; however for brief periods (a few hours to a few days) they may be found at locally higher densities as they aggregate near physical (e.g. horizontally along physical fronts, or vertically near the main thermocline) or biological discontinuities (e.g. phytoplankton “thin layers”). Copepods eat phytoplankton, microzooplankton, and other smaller crustacean zooplankton, and in turn are food for krill, fish larvae, and small pelagic fish. An important feature of many of the larger crustacean zooplankton is that they undergo daily vertical migrations from depths as deep as several hundred meters during the day up to near the surface at night, primarily as a means to avoid visual predators such as fish. Unlike many other zooplankton, several of the dominant species of copepods, those of the genus *Calanus* and *Neocalanus* in particular, undergo a wintertime dormant period, wherein they descend to depths of about 400 to 1000 m for anywhere from 4-8 months of the year. They emerge in the springtime to reproduce. Thus copepods have a marked seasonality in their availability to higher trophic levels, often leading to match-mismatch problems.

Unicellular microzooplankton include a diverse array of organisms, such as heterotrophic dinoflagellates, ciliates, and choanoflagellates. These organisms primarily eat other microzooplankton, phytoplankton, cyanobacteria, and bacteria. The CCE biomass of unicellular microzooplankton is not often high; however, their grazing rates are on par with the growth rates of phytoplankton. Thus it is these unicellular microzooplankton, not crustaceans or fish, which consume the majority of phytoplankton standing stock and production within many areas of the CCE. Unicellular microzooplankton are a key prey source for gelatinous zooplankton, copepods, and other small crustacean zooplankton due to their enriched nitrogen relative to carbon, in comparison to similarly sized phytoplankton (PFMC, 2012a).

4.3 BENTHIC INVERTEBRATES

Benthic organisms, due to their habitat in and around the sea floor, are generally sensitive to deposition of solids such as seafood waste, and can be considered indicators of the intensity of pollution. Benthic invertebrates are important as prey for higher trophic levels and as mediators for nutrient recycling. Several benthic species such as crab, scallop, and shrimp are harvested commercially.

In general, polychaetes, bivalves, and small crustaceans, primarily amphipods, are the most abundant organisms. Polychaetes often constitute the majority of the infauna (species living in the sediment), while arthropods, molluscs, and echinoderms constitute the majority of the epifauna (species living on the surface of the seabed).

Benthic invertebrates may consume zooplankton, small fish and other smaller benthic invertebrates. Many of these species are important prey items for higher trophic level consumers such as fish (ADEC, 2008).

4.4 FISH

Fish living in the EEZ off the U.S. Pacific Northwest can be grouped into anadromous fish, groundfish, coastal pelagic species, and highly migratory species. Non-fish invertebrates such as cephalopods, jellyfish, and crustaceans are also important mid to high trophic level members of the marine ecosystem. Selected fish species are further described below.

4.4.1 Anadromous Fish

Anadromous fish are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn. Species found in this area include several salmon species, steelhead, American shad, eulachon, green and white sturgeon, and pacific lamprey. Species that are listed as threatened or endangered under the ESA, such as Chinook, chum, coho, and sockeye salmon, steelhead, eulachon, and green sturgeon are discussed in Section 6. Others are discussed below.

4.4.1.1 Pink Salmon

Pink salmon (*Oncorhynchus gorbuscha*) range from Northern California to the Bering Sea. The most significant spawning populations of pink salmon occur north of Oregon. The pink salmon is a carnivorous and opportunistic feeder throughout its life, feeding on insects, crustaceans, invertebrates, and other fish. In turn it is eaten by other fish, marine mammals, and humans. Pinks spend the least time in freshwater environments as compared to the other salmon species.

The pink salmon has a two-year life span. Adults return from the ocean as two year olds between June and September and migrate only short distances to the lower reaches of streams or inter-tidal areas where they were born. All pink die within weeks after spawning. Eggs commonly hatch between December and January. The young stay hidden in the gravel for 4 to 5 months. After their emergence from the gravel in April or May, the young quickly migrate downstream. They spend little time in estuaries, moving quickly out into near-shore shallow marine waters. As they feed and grow, they move out into the open ocean, where they remain for the next year and a half until it is time for them to spawn.

U.S. commercial landings of pink salmon averaged 310 million pounds annually from 1989-93, second only to sockeye salmon; over 90% of the catch is from Alaskan waters. Recreational fisheries do exist for pink salmon in Washington and Alaska, virtually none exist in Oregon and California (PSMFC a).

4.4.1.2 American Shad

American shad (*Alosa sapidissima*) range along the Pacific coast from California to Alaska. The shad is a plankton feeder whose diet varies depending upon geographical region. Throughout its life a shad consumes copepods, amiphipods, shrimp, zooplankton, and other small fishes. In freshwater the shad falls prey to white sturgeon, juvenile salmonids, harbor seals, and other predators, while in the ocean phase of life a shad is preyed upon by sharks, tuna, sea lions, and others.

The American shad is a highly migratory anadromous species that returns to its freshwater natal (birth) areas to spawn. Shad spawn in estuaries, streams, and rivers in the spring and early summer months. Males and females may return to spawn more than once, and female shad can produce 30,000 to 600,000 eggs. The fertilized eggs float downstream and hatch in 3 to 10 days. Juvenile shad tend to survive best in the slow waters of reservoirs. They migrate downstream during late summer and fall, with most migrating to the open ocean before winter. Some shad will reside in rivers and estuaries up to one year before entering the ocean. Shad normally spend 3-4 years at sea before returning to spawn.

Sport fisheries for shad have been building for years in the Pacific Northwest. Shad are used as bait for other fisheries and are considered good fighting sportfish that are rich in flavor and have excellent roe. Due to poor market demand and incidental catches of protected salmon runs, significant commercial fisheries do not exist in the Pacific Northwest (PSMFC a).

4.4.1.3 Pacific Lamprey

The Pacific Lamprey (*Lampetra tridentatus*) ranges from Baja California to the Bering Sea in Alaska, and is also found in Asia.

Lamprey enter streams from July to October; spawning takes place the following spring. Adults die within four days of spawning. The young hatch in 2-3 weeks and subsequently stay burrowed in the mud for 4 to 6 years, moving only rarely to new areas. After a two month metamorphosis triggered by unknown factors, they emerge as adults averaging 4.5 inches long. Then during high water periods in late winter or early spring the new adults migrate to the ocean. During the ocean phase of life, Pacific lamprey are scavengers, parasites, or predators on larger prey such as salmon and marine mammals. After 2 to 3 years in the ocean they return to freshwater to spawn.

The Pacific lamprey has little or no economic value in the Pacific Northwest. Before its decline the lamprey was a very important fish for many of the Tribal people of the Pacific coast and interior Columbia River basin. Tribal people harvested these fish for subsistence, ceremonial, and medicinal purposes (PSMFC a).

4.4.1.4 White Sturgeon

White sturgeon (*Acipenser transmontanus*) are slow growing, late maturing anadromous fish found in most estuaries along the Pacific coast from Ensenada, Mexico to Cook Inlet, Alaska. They spawn in large rivers in the spring and summer months and remain in fresh water while young. Older juveniles and adults are commonly found in rivers, estuaries, and marine environments. It is estimated that white sturgeon reach maturity in 5-11 years. They can spawn multiple times during their life, and apparently spawn every 4-11 years as they grow and mature. Adults primarily feed on fish, shellfish, crayfish, and various aquatic invertebrates such as clams, amphipods, and shrimp (PSMFC a).

4.4.2 Groundfish

Groundfish generally live on or near the bottom of the ocean. There are over 90 species, including:

- **Rockfish** such as widow, yellowtail, canary, shortbelly, and vermilion rockfish; bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch.
- **Flatfish** such as, including various soles, starry flounder, turbot, and sanddab.
- **Roundfish** such as lingcod, cabezon, kelp greenling, Pacific cod, Pacific whiting (hake), and sablefish.
- **Sharks and skates** such as leopard shark, soupfin shark, spiny dogfish, big skate, California skate, and longnose skate.
- **Other species** such as ratfish, finescale codling, and Pacific rattail grenadier.

Many groundfish feed on a variety of benthic invertebrates, such as worms, mollusks, and crustaceans. Juveniles often feed on demersal eggs and larvae, but may be planktivorous. Depending on the species, some groundfish prey on other fish, including some pelagic fish. Many are opportunistic feeders, so specific food sources depends on availability.

As the name suggests, groundfish are generally demersal for most of their lives. Nevertheless, only a small number of Pacific groundfish species lay demersal eggs. The rest either give birth to live young or lay eggs that are pelagic or epipelagic. The exceptions to this are rock sole, most roundfish, skates, and ratfish (PFMC, 2005b).

4.4.3 Coastal Pelagic Species

Coastal Pelagic Species (CPS) include the northern anchovy, Pacific sardine, Pacific mackerel, and jack mackerel. Species descriptions can be found in Section 7.3.1. Pelagic means they generally occur in the water column as opposed to living near the sea floor. They can be found anywhere from the surface to 1,000 meters (547 fm) deep (PFMC a). Eggs laid by female CPS remain at or near the surface of the ocean (PFMC, 1998). Primarily feeding on planktonic crustaceans and fish larvae, they are in turn an important food source for many species of fish, marine mammals and birds (PSMFC a).

4.4.4 Highly Migratory Species

The term “highly migratory species” (HMS) derives from Article 64 of the United Nations Convention on the Law of the Sea. Although the Convention does not provide an operational definition of the term, an annex to it lists species considered highly migratory by parties to the Convention. In general, these species have a wide geographic distribution, both inside and outside countries’ 200-mile EEZs, and undertake migrations of significant but variable distances across oceans for feeding or reproduction. They are pelagic species, which means they do not live near the sea floor, and mostly live in the open ocean, although they may spend part of their life cycle in nearshore waters. They are harvested by U.S. commercial and recreational fishers and by foreign fishing fleets. Only a small fraction of the total harvest is taken within U.S. waters (PFMC d).

Highly migratory species include:

- Tunas: north Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin
- Sharks: common thresher, pelagic thresher, bigeye thresher, shortfin mako, blue
- Billfish/swordfish: striped marlin, Pacific swordfish
- Other: dorado (also known as dolphinfish and mahi-mahi)

Exact diet varies from species to species, but HMS generally feed on a variety of fish, crustaceans and cephalopods. Juveniles may feed on zooplankton and fish larvae (PFMC, 2007).

4.5 SEABIRDS

A seabird is a bird that spends most of its life in the open ocean. They are highly specialized and adapted to life in the sea. Most have thick, waterproof feathers to keep them warm and a special gland near their eyes helps them remove salt from their food and the water. A seabird's beak, as with all birds, is adapted to the type of food it eats. Their sharp, pointed beaks catch and hold slippery fish and strong, pointed wings help certain seabirds "fly" underwater when pursuing their prey. Other seabirds, like albatross, have longer wings that allow them to fly far out to sea. Webbed feet, common to all seabirds, help them chase their prey. Most seabirds rest and sleep on the waves, while others roost on land for a few hours a day. All seabirds must return to land to lay eggs and raise their young. At the start of summer, seabirds will gather on offshore islands and rock outcroppings to form often crowded colonies where they will breed and nest. Their diet consists mostly of small fish, squid, shellfish, and crustaceans such as krill and crabs (USFWS b).

Seabirds have relatively long life spans compared to most terrestrial birds, low adult mortality rates, relatively late sexual maturity, and small clutch sizes. There are records of several species of seabirds reaching 20 and even 30 years of age in the wild. Long life spans in a species imply a low annual rate of adult mortality; annual mortality rates below 20% are common in seabirds. Some albatrosses have annual mortality rates as low as 3% whereas many common terrestrial birds have annual mortality rates from 40 to 70%. If mortality rates remain constant with increasing age, large seabirds with very low annual mortality rates may attain a breeding life of 50 years or more. Recruitment of birds into the breeding population is often slow and delayed. Before attaining maturity, many seabirds spend at least 2 years, more commonly 3-5, and up to 9 years as non-breeders. The clutch size of seabirds is usually low, ranging from one to three for most species. By contrast, land birds lay from 7 to 15 eggs per clutch, and many produce two or more broods each year.

Seabirds tend to be of two types: those which spend most of their time near shore and usually roost on shore (including cormorants, pelicans, and gulls), and those which come to land only during the breeding season or sometimes intermittently during other times of the year (including storm-petrels and alcids). Of the truly pelagic seabirds, several are nocturnal on the breeding grounds, entering or leaving colonies only at night.

The colony site is a very critical habitat for seabirds because reproduction and thus continuation of species depend on these sites. At other times of the year, seabirds may be able to avoid problems, such as disruption of food supplies and perhaps even large oil spills, simply by flying somewhere else, but for successful reproduction they are limited to the area around the colony.

Disturbance-induced stress and mortality are probably the most important long-term factors affecting marine bird populations. Major forms of disturbance to seabirds include boating, scuba diving, military operations, encounters with domestic animals, habitat loss, effects of commercial fishing (both direct mortality due to entrainment in gear and indirect effects such as reduction in prey availability), oil pollution, and exposure to toxic substances. The effects of disturbances vary depending on species, nesting stage, and the type, duration, timing, and intensity of the disturbance. Impacts range from slight disruption of courtship behavior, incubation, and feeding of nestlings, to outright mortality of nestlings from exposure to heat or cold and induced predation.

The long-term summation of all disturbance events is of great concern. Long breeding lives, low recruitment rates, and delayed maturity could delay the detection of the effects of disturbances on successive breeding populations for several years. Therefore careful and frequent monitoring of seabird populations is warranted (Speich and Wahl, 1989).

At least fifteen species of seabird are found offshore of Washington and Oregon. Because the marbled murrelet and short-tailed albatross are listed under the ESA, they are discussed in Section 6. The rest of the major resident species are listed in Table 4.1 and further discussed below. The abundance estimates in the table are based on the most recent statewide catalogs of seabird colonies published by the United States Fish and Wildlife Service (USFWS) in their Biological Report series. The Oregon data are from Naughton et al. (2007) and the Washington data are from Speich and Wahl (1989).

Table 4.1 Seabird Populations

Species	Breeding bird population estimate		
	Oregon	Washington	Total
Brandt's Cormorant	21,200	554	21,754
Double-crested Cormorant	30,400	3,296	33,696
Pelagic Cormorant	10,100	4,866	14,966
Common Murre	685,000	30,780	715,780
Pigeon Guillemot	4,500	4,270	8,770
Tufted Puffin	4,600	23,342	27,942
Rhinoceros Auklet	500	60,814	61,314
Cassin's Auklet	400	87,600	88,000
Western and Glaucous-winged Gulls	32,300	39,923	72,223
Caspian Tern	19,000	7,918	26,918
Leach's Storm-Petrel	482,000	35,700	517,700
Fork-tailed Storm-Petrel	Hundreds	3,878	Over 4000
Brown Pelican	See Text		

In addition to the resident species listed in the table above, large numbers of non-nesting birds migrate through the coastal Pacific Northwest in spring and fall, and many more birds of many species winter along the coast and in protected waters. These include shearwaters from as far away as Tasmania, New Zealand, and Chile; many species of loons; shorebirds and waterfowl from arctic Alaska and Canada; gulls from the Arctic and from Mexico; and inland-nesting species of grebes and gulls (Speich and Wahl, 1989).

4.5.1 Brandt's Cormorant

Brandt's Cormorants (*Phalacrocorax penicillatus*) are found in marine and estuarine areas along the Pacific coast from Alaska to Baja. They nest colonially on offshore rocks and are the most common of the cormorants on the Oregon coast in the summer. They begin laying eggs in late March or early April in nests constructed of seaweed, algae, grasses and mosses. Four to six eggs are laid and the 30 day incubation is shared by both sexes. Altricial young are fed by regurgitation. Brandt's Cormorants hunt for schooling fish in the upper water column. Like all cormorants, their feathers are not waterproof, which decreases their buoyancy, making it easier for them to catch their prey. Their longevity record is 17 years (USFWS b).

4.5.2 Double-crested Cormorant

Double-crested Cormorants (*Phalacrocorax auritus*) are common on the coasts of North America. They are found in the Pacific from the Aleutian Islands to Mexico. They are colonial nesters on offshore rocks, cliff ledges, trees, and islands. Nests are built mainly from sticks and are reused year after year. Laying begins in mid-March, consisting of three to four eggs. Incubation lasts 25-29 days and is done by both sexes. Altricial young fledge at five to six weeks. Double-crested Cormorants feed on bottom dwelling fish away from shore and the young are fed by regurgitation. In order to make deep underwater dives, cormorants have the ability to wet the outer layer of their feathers, reducing buoyancy and allowing them to pursue prey further down in the water column. To dry their feathers they perch and spread their wings to the sun. Record of longevity is 18 years (USFWS b).

4.5.3 Pelagic Cormorant

Pelagic Cormorants (*Phalacrocorax pelagicus*), also known as Baird's Cormorants, are found along the Pacific coast from the Aleutian Islands south to Baja Mexico. They are common year-round in the U.S. Pacific Northwest. Pelagic cormorants are so named because they are strictly marine birds. They are colonial nesters, using rocky cliffs and ledges to build nests made of seaweed, plant debris, and guano. Breeding begins at two to three years of age. Laying begins in late March, with a clutch of three to five eggs. Incubation is 26-28 days by both sexes. The young are fed by regurgitation. Pelagic Cormorants are foot-propelled divers and their diet consists of bottom fish such as rockfish and sole, which they capture near shore. Longevity record is 18 years. The colony at Cape Foulweather, Oregon is one of the largest on the Pacific coast (USFWS b).

4.5.4 Common Murre

Common Murres (*Uria aalge*), otherwise known as Common Guillemots, are large auks (alcids) found in the North Pacific and North Atlantic. In the Pacific they range from western Alaska and the Aleutian Islands to central California. Common Murres nest on rocky islands and cliff ledges in colonies of tens or hundreds of thousands of birds. They do not breed until four or five years of age. In Oregon, they begin laying in late April. No nest is built; instead a single egg is laid on bare rock and held on the tops of their feet during the 28-35 day incubation, which is shared by both sexes. After the chick hatches the adult female flies north to molt while the male leads unfledged young on a swimming migration north to the protected waters of Washington and British Columbia. Young birds are able to fly approximately forty-two days after hatching. Common Murres are capable of diving more than 180 meters (approximately 600 feet) deep and can "fly" underwater. They feed on schooling fish, crustaceans, and mollusks. Their longevity record is 26 years (USFWS b).

4.5.5 Pigeon Guillemot

The Pigeon Guillemot (*Cepphus columba*) is a medium-sized alcid endemic to the Pacific, where they can be seen flying low over the water along rocky coastlines or estuaries. They breed from northern Alaska to southern California. Their habitat consists of marine and estuarine waters though they prefer sheltered waters rather than exposed coastlines. Pigeon Guillemots nest on talus slopes, human made structures, rock crevices, or burrows in soil, mostly in loose colonies of less than forty birds. Guillemots can fly underwater and use their feet as rudders to catch their prey. Unlike most other alcids, which lay only one egg, they lay two. Laying begins in May and incubation lasts 28-30 days by both sexes. The young fledge and become independent in thirty to forty days. They feed on nearshore fish and feed their young by carrying a single fish back to the nest. Pigeon Guillemots winter at sea, sometimes moving north during the winter. The longevity record is 12 years (USFWS b).

4.5.6 Tufted Puffin

Tufted Puffins (*Fratercula cirrhata*) have the most extensive latitudinal distribution of all the alcids, ranging from Japan through the Aleutian Islands south to Oregon and southern California. They nest on coastal rocks where soil-topped islands exist. They are colonial nesters although they will nest singly. Their nests are found at the end of burrows in the soil that can be up to six feet long, and are usually lined with dry grasses and feathers. In April, laying begins with a clutch of a single egg. Incubation is 44 days by both sexes. Young will fledge at 49 days but can leave the burrow before that time. Tufted Puffins need enough of a slope to give them sufficient lift for take-off from the rock or nest site location. Although they are not the most graceful birds in the air they make up for it underwater where they can truly fly. Anchovies, smelt, sand lance, and herring make up most of their diet. The young are fed small fish that are carried in the adults' beaks three or four at a time. Tufted Puffins winter at sea and are rarely seen from land during that time. Their longevity record is six years (USFWS b).

4.5.7 Rhinoceros Auklet

Rhinoceros Auklets (*Cerorhinca monocerata*) are found breeding from Alaska to southern California. They are distinctly different in appearance from other alcids; during the breeding season they grow a vertical horn-like structure at the base of the upper mandible. In non-breeding plumage the horn is significantly reduced in size. They nest in small numbers on offshore islands. Like the Tufted Puffin, they build nests in burrows which can be up to twenty feet long and will be used repeatedly. Laying begins in late April and the clutch consists of a single egg with an incubation period of 39-52 days shared by both sexes. Closely related to the puffin, the Rhinoceros Auklet also feeds on sand lance, herring, anchovies, and smelt. They are usually nocturnal at the colony to avoid predation by gulls. Chicks are fed twice a night, once by each parent. These seabirds winter at sea, usually south of breeding areas. The longevity record for the Rhinoceros Auklet is eight years (USFWS b).

4.5.8 Cassin's Auklet

Cassin's Auklets (*Ptychoramphus aleuticus*) breed from Alaska to Baja Mexico, but 76% breed in British Columbia. In Oregon, there are less than a dozen sites and fewer than 1,000 birds. Like the Rhinoceros Auklet and Tufted Puffin, they dig burrows for their nests, typically two to six feet long. They will also use natural cavities such as caves and crevices. Nest cavities can be unlined or lined with plant material. The nest site is used repeatedly by the same pair. They begin laying in late April on soil covered offshore rocks. Cassin's Auklets visit the colony only at night to escape the danger of predators. One egg is laid with an incubation period of 39 days shared by both sexes. Young are fed at night by regurgitation. Diet consists of euphausiids and other crustaceans. At 40 to 50 days the independent young leaves the burrow. Cassin's Auklet is the only known Northern Hemisphere seabird that can raise two broods in a season. They spend the winter at open sea and are the most common alcid seen at sea in Oregon. The longevity record for the Cassin's Auklet is 16 years (USFWS b).

4.5.9 Western Gull

Western Gulls (*Larus occidentalis*) can be found from British Columbia to Baja Mexico. Their population is the smallest of any North American gull but the most abundant on the Oregon coast. They are present in Oregon year-round and breed along the entire coast. The Western Gull breeds primarily on islands and offshore rocks, often in sheltered areas, but will also use human-made structures and mainland cliffs. Early May marks the beginning of egg laying. Clutches have two to three eggs and incubation is 24-29 days done by both sexes. Young fledge at six to seven weeks. Western Gulls are one of the most opportunistic feeders and aggressive scavengers. They will often prey on the young of other nesting seabirds. Their longevity record is 28 years (USFWS b).

4.5.10 Caspian Tern

The breeding distribution of the Caspian Tern (*Sterna caspia*) is extensive, including the Pacific, Atlantic, and Gulf coasts, Great Lakes, and Great Basin region. The Caspian Tern can be found in marine, brackish, and freshwater habitats. They are colonial nesters, nesting on beaches or sandy areas on islands. Mid-April is when egg laying begins. Clutches of two to three eggs are laid on bare sand. Incubation, shared by both sexes, is 26-28 days. Young are fed a single fish and will fledge at 25-30 days. Parents may continue to feed the young several months after fledging. Caspian Terns are almost entirely piscivorous and feed on salmon, herring, perch, smelt, and occasionally crayfish or insects. Their longevity record is 30 years. The largest Caspian tern colony in the world is on East Sand Island in the lower Columbia River (USFWS b).

4.5.11 Leach's Storm-Petrel

Leach's Storm-Petrels (*Oceanodroma leucorhoa*) are present in both the north Atlantic and north Pacific. Breeding grounds in the Pacific range from Japan to Alaska and the Aleutian chain south to Baja Mexico. The smallest pelagic breeding seabird in Oregon, they will fly more than 100 miles offshore to feed. Leach's Storm-Petrels winter in tropical waters within 20° of the equator. They are colonial burrow nesters and nest on offshore islands with soft soil cover. Burrows are usually two to three feet long and shaped at an angle. One egg is laid in mid-late May with a 41-42 day incubation period. Chicks are fed a variety of foods including by-the-wind-sailors, shrimp, copepods, fish, and squid. They are fed by regurgitation, some of which has been converted to lipid-rich oil. Young leave for sea at 63-70 days. Adult diet consists mostly of euphausiids and zooplankton. These seabirds have a well-developed sense of smell allowing them to locate their burrows and food sources by smell. The longevity record for this species is 31 years. Leach's Storm Petrels are not often seen due to their distant offshore flying and nocturnal habits (USFWS b).

4.5.12 Fork-tailed Storm-Petrel

Fork-tailed Storm-Petrels (*Oceanodroma furcata*) are among the smallest seabirds, yet they range far from land over the mid-ocean waters. They usually feed on surface plankton, but they follow fishing vessels and forage on oil and offal when the opportunity arises. They are abundant over large areas of the cooler waters of the North Pacific and are frequently seen over the outer continental shelf waters of Washington and pelagic waters farther offshore. Fork-tailed Storm-Petrels breed on offshore islands where they are secure from land-based predators. Throughout their range they nest in rocky crevices and, to a lesser extent, in soil burrows. To avoid diurnal predators, colony activity occurs during the darkest hours of the night (Speich and Wahl, 1989).

4.5.13 Brown Pelican

Brown pelicans (*Pelecanus occidentalis*) inhabit the Atlantic, Pacific, and Gulf coasts of North and South America. On the Pacific coast they are found from British Columbia to south-central Chile and the Galapagos Islands. Pelicans are primarily fish-eaters, relying heavily on anchovies and sardines in their Pacific habitat, but have also been known to eat some crustaceans such as prawns. They dive from the air to catch their prey. The birds nest in large colonies on the ground, in bushes, or in the tops of trees. On the west coast, nesting colonies are generally found in southern California. Peak egg-laying usually occurs from March through May. The female typically lays two to three eggs that hatch in about a month. They can live up to 30 years. Brown pelicans were listed as endangered in 1970 under the precursor to the Endangered Species Act, but were delisted in November 2009 due to population recovery. Abundance estimate for the southern California subpopulation was estimated to be more than 11,000 breeding pairs in 2009 (USFWS, 2009b).

4.6 MARINE MAMMALS

Several species of marine mammals occur in the EEZ off the coast of Washington and Oregon, including cetaceans, pinnipeds, and sea otters. All marine mammals are protected under the Marine Mammal Protection Act (MMPA) of 1972. Additional protection is provided under the Endangered Species Act (ESA) for some species; these are further discussed in Section 6. Estimates of the role of cetaceans and pinnipeds in the California Current Ecosystem suggest that they annually consume on the order of 3 to 4 million tons of prey including krill, coastal pelagic fishes, squids, and groundfish (PFMC, 2012a).

4.6.1 Pinnipeds

Pinnipeds are fin-footed animals which live in the open ocean, but come ashore to breed, give birth, and nurse their young. Pinnipeds that are likely to be found in these waters include the Steller sea lion, California sea lion, harbor seal, and northern fur seal.

4.6.1.1 Steller Sea Lion

The present range of Steller sea lions extends around the North Pacific Ocean rim from northern Japan, the Kuril Islands and Okhotsk Sea, through the Aleutian Islands and Bering Sea, along Alaska's southern coast, and south to California (Kenyon and Rice, 1961; Loughlin et al., 1984 & 1992; Burkanov and Loughlin, 2005). Seal Rocks, at the entrance to Prince William Sound, Alaska, is the northernmost rookery (60°09'N). Año Nuevo Island off central California is the southernmost rookery (37°06'N) (NMFS, 2008).

Steller sea lions forage in nearshore and pelagic waters. They are opportunistic predators, feeding primarily at night on a wide variety of fishes (e.g., capelin, cod, herring, mackerel, pollock, rockfish, salmon, sand lance, etc.), bivalves, cephalopods (e.g., squid and octopus) and gastropods. Their diet may vary seasonally depending on the abundance and distribution of prey. They may disperse and range far distances to find prey, but are not known to migrate. They can dive to approximately 1300 ft (400 m) in depth.

They use land habitat as haul-out sites for periods of rest and molting, and as rookeries for mating and pupping during the breeding season. At sea, they are seen alone or in small groups, but may gather in large "rafts" at the surface near rookeries and haul outs. Steller sea lions are colonial breeders.

In 1990, Steller sea lions in the action area were listed as a threatened species under the Endangered Species Act. In 2013 they were delisted and now have a status of recovered.

4.6.1.2 California Sea Lion

Although the breeding areas of the California sea lion (*Zalophus californianus*) are on islands off the coasts of southern California and Baja California, animals from the Pacific Temperate population range north into Canadian waters, and may therefore be found off the coasts of Washington and Oregon. They feed mainly in upwelling areas on a variety of prey such as squid, anchovies, mackerel, rockfish, and sardines. They also take fish from commercial fishing gear, sport-fishing lines, and at fish passage facilities at dams and rivers.

There has generally been a steady increase in population since the 1970s, although El Niño years tend to cause temporary reductions in abundance. The most recent estimate for the U.S. Stock from 2008 is about 300,000 sea lions. California sea lions are not listed as “depleted” or “strategic” under the MMPA. They are at risk of incidental entanglement in fishing gear; however, the total fishery mortality and serious injury rate is considered to be insignificant and approaching zero. Other hazards include collisions with boats and cars, shootings, and entrainment in power plants. Sporadic harmful algal blooms can produce domoic acid, a neurotoxin which has been linked to sea lion mortality (Carretta et al., 2012).

4.6.1.3 Harbor Seal

Harbor seals (*Phoca vitulina*) inhabit marine, estuarine, and freshwater areas off the west coast from Baja California all the way north and west to Alaska. They prefer gently sloping or tidally exposed habitats including reefs, offshore rocks and islets, mud and sand bars, and sand and gravel beaches, and are typically found in water depths less than 180 feet (ADEC, 2008). Therefore they are not expected to be found in large numbers in the Draft Permit action area, which includes waters greater than 210 feet in depth. These animals are generally non-migratory and display a strong fidelity to haulout sites. The seals dive to hunt their prey, which is highly varied and includes fish, shellfish, and crustaceans.

The most recent population estimate for the Washington/Oregon coastal stock was around 25,000 seals in 1999. The population increased steadily in the first two decades following the passage of the MMPA in 1972, and has leveled off since then. This stock is considered to have reached carrying capacity. No harbor seal stocks have been identified as “depleted” under the MMPA or considered for listing under the ESA (Carretta et al., 2012).

4.6.1.4 Northern Fur Seal

The northern fur seal (*Callorhinus ursinus*) range extends from the Bering Sea south to southern California. These seals are migratory and widely dispersed in pelagic waters throughout this range during the non-breeding season. During the summer breeding season, most of the population is found ashore on the Pribilof Islands in the Bering Sea. In the late fall, adult females and pups from the Pribilof Islands move through the Aleutian Islands into the North Pacific Ocean, often to the waters offshore of Oregon and California. Adult males generally move only as far south as the Gulf of Alaska in the eastern North Pacific. Northern fur seals forage in the open ocean on a variety of fish including pollock. This species was designated as depleted under the MMPA in 1988 because population levels had declined to less than 50% of levels observed in the late 1950s. The population has continued to decline since then, with the most recent estimate for the Eastern Pacific stock being 653,171 seals (Allen and Angliss, 2012).

Historical declines in northern fur seals were caused by unregulated commercial harvests, but the population seemed to have rebounded to pre-harvest levels by the 1950s. The factors responsible for the decline in population since then are poorly understood. Current threats include predation by killer whales, changes in the availability of prey, bycatch in fishing gear, habitat degradation due to pollution and climate change, entanglement in marine debris, and disturbance from vessels and humans (NMFS w).

4.6.2 Cetaceans

Cetaceans include whales, dolphins and porpoises. Endangered whale species (blue, fin, humpback, killer, sei, and sperm) are discussed in Section 6. Non-ESA listed species are discussed below.

4.6.2.1 Porpoises

Two species of porpoise are found in the Draft Permit action area. Neither is listed as “depleted” under the MMPA or listed as “threatened” or “endangered” under the Endangered Species Act.

<u>Dall’s Porpoise</u>

Dall’s porpoises (*Phocoenoides dalli dalli*) are found throughout the North Pacific, preferring temperate to boreal (northern) waters that are more than 600 feet deep and with temperatures between 36°F (2°C) and 63°F (17°C). Off the U.S. west coast, they are commonly seen in shelf, slope and offshore waters (Carretta et al., 2012).

Food sources include small schooling fish (e.g., anchovies, herring, and hake), mid- and deep water fish (e.g., myctophids and smelts), cephalopods (e.g., squid and octopus), and occasionally crabs and shrimp. Feeding usually occurs at night when their prey vertically migrate up toward the surface. Dall's porpoises are capable of diving up to 1640 feet (500 m) in order to reach their prey. Calving generally occurs between June and September (NMFS w).

Migration occurs based on seasonal and inter-annual oceanographic changes, so the population distribution can be highly variable. The current estimate in waters off California, Oregon and Washington, based on data from 2005 and 2008 surveys, is 42,000 animals. No information is available regarding trends in abundance. No habitat issues are known to be of concern for this species. While incidental catch in gillnet and trawl fisheries does occasionally occur, the average annual human-caused mortality is thought to be less than 1 animal per year (Carretta et al., 2012).

<u>Harbor Porpoise</u>

Harbor porpoises (*Phocoena phocoena*) inhabit northern temperate and subarctic coastal and offshore waters. They are commonly found in bays, estuaries, harbors, and fjords less than 650 ft (200 m) deep. Breeding occurs from June or July to October with peak calving in May and June. They feed on demersal and benthic species, mainly schooling fish and cephalopods (NMFS w).

Species range includes both the Atlantic and Pacific Oceans. In the Pacific, they are found in coastal and inland waters from California to Alaska and across to Kamchatka and Japan. They are known to occur year-round along the Oregon/Washington coast. The U.S. population is divided into several different stocks based on geographic area, because individuals do not tend to migrate far or breed with members of other stocks. The two that are relevant to the Draft Permit action area are the Northern California/Southern Oregon and the Northern Oregon/Washington Coast stocks, with the dividing line between the two at Lincoln City, OR (Carretta et al., 2012).

Based on pooled 2002-2007 data, the most recent estimate of abundance for the Northern California/Southern Oregon stock is 39,581 porpoises. The most recent estimate for the Northern Oregon/Washington Coast stock is 15,674 porpoises, from 2002. Information is not available on population trends. Incidental catch in gillnet fisheries occurs at a rate of a few porpoises per year combined from these two stocks (Carretta et al., 2012).

4.6.2.2 Dolphins

Six species of dolphins are found in the Draft Permit action area. Dolphins are highly social animals which are commonly found in groups. They are capable of diving for several minutes in search of prey, which generally includes fish and cephalopods (e.g., squid). Feeding often occurs as night when prey move closer to the surface. Dolphin calves are generally born in the summer months (NMFS w).

The most recent abundance estimates for the California/Oregon/Washington stocks of these species, shown in Table 4.22, are based on ship surveys conducted in 2005 and 2008. There is insufficient data available to determine trends in abundance. Distributional shifts in population occur based on ocean temperature changes. No habitat issues are known to be of concern for the dolphin species in this area. They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Dolphins are susceptible to being caught in fishery gear such as gillnets. However recent human-caused (including fishery-related) mortality is considered to be insignificant (Carretta et al., 2012).

Table 4.2 Most Recent California/Oregon/Washington Stock Population Estimates for Dolphin Species

Species	Population estimate
Bottlenose dolphin	1,006
Short-beaked common dolphin	411,211
Northern right whale dolphin	8,334
Pacific white-sided dolphin	26,930
Risso’s dolphin	6,272
Striped dolphin	10,908

Bottlenose Dolphin

Bottlenose dolphins (*Tursiops truncatus*) are distributed world-wide in tropical and warm-temperate waters. In many regions separate coastal and offshore populations are known. Offshore bottlenose dolphins have been found at distances greater than a few kilometers from the mainland. They have been documented as far north as about 41° N (northern California), and may range into Oregon and Washington waters during warm-water periods (Carretta et al., 2012).

Short-beaked Common Dolphin

Short-beaked common dolphins (*Delphinus delphis*) are the most abundant cetacean off California, and are widely distributed between the coast and at least 300 nm from shore. They have been commonly sighted as far north as the California/Oregon border during vessel surveys over the last two decades, and occasionally range into waters off Oregon and Washington (Carretta et al., 2012).

Short-beaked common dolphins prefer warm tropical to cool temperate waters (52-88° F or 10-28° C) that are primarily oceanic and offshore, but still along the continental slope in waters 650-

6,500 ft (200-2,000 m) deep. They prefer waters altered by underwater geologic features where upwelling occurs (NMFS w).

Northern Right Whale Dolphin
Northern right-whale dolphins (*Lissodelphis borealis*) are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they have been seen primarily in shelf and slope waters. Seasonal north-south movements occur, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer (Carretta et al., 2012).

Pacific White-sided Dolphin
Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) are endemic to temperate waters of the North Pacific Ocean, and are common both on the high seas and along the continental margins. Off the U.S. west coast, they have been seen primarily in shelf and slope waters. Sighting patterns from recent surveys suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer (Carretta et al., 2012).

Risso's Dolphin
Risso's dolphins (*Grampus griseus*) are distributed world-wide in tropical and warm-temperate waters. Off the U.S. West coast, they are commonly seen in slope and offshore waters of California, Oregon and Washington. Based on recent surveys, animals found off California during the colder water months are thought to shift northward into Oregon and Washington as water temperatures increase in late spring and summer (Carretta et al., 2012).

Striped Dolphin
Striped dolphins (*Stenella coeruleoalba*) are distributed world-wide in tropical and warm-temperate pelagic waters. They are commonly seen at 100-300nm from the coast off of California. Recent surveys did not yield sightings offshore of Oregon and Washington, but it is believed they may occasionally be found there (Carretta et al., 2012).

4.6.2.3 Whales
Fourteen types of whale are found in the Draft Permit action area. Six of these are endangered; these are discussed in Section 6. The remaining eight are described below. The most recent abundance estimates for the California/Oregon/Washington stocks (or the Eastern North Pacific Offshore stock, in the case of killer whales) of these species, shown in Table 4.33, are based on ship surveys conducted within 300 nm of the coasts of California, Oregon and Washington in 2005 and 2008. There is insufficient data available to determine trends in abundance. No habitat issues are known to be of concern for these species, but in recent years questions have been raised regarding potential effects of human-made sounds such as sonar on deep-diving cetaceans that use sound to feed, communicate, and navigate in the ocean. For species with sufficient data, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. They are not listed as "depleted" nor as “strategic” stocks under the MMPA (Carretta et al., 2012).

Table 4.3 Most Recent Population Estimates for Whale Species within 300 nm of the Coasts of California, Oregon and Washington

Species or type	Population estimate
Baird’s beaked whale	907
Cuvier’s beaked whale	2,143

Species or type	Population estimate
Killer whale (Eastern North Pacific Offshore stock)	240
Mesoplodont beaked whales (multiple species)	1,024
Minke whale	478
Dwarf sperm whale	unknown
Pygmy sperm whale	579
Short-finned pilot whale	760

Baird's beaked whale

Baird's beaked whales (*Berardius bairdii*) are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean. Along the U.S. west coast, Baird's beaked whales have been seen primarily along the continental slope from late spring to early fall. They have been seen less frequently and are presumed to be farther offshore during the colder water months of November through April (Carretta et al., 2012).

Baird's beaked whales are usually found in tight social groups (schools or pods) averaging between 2-20 individuals, but have been occasionally seen in larger groups of up to 50 animals. Like other beaked whales, they are deep divers. Regular dives range from 11-30 minutes, commonly reaching depths of 1,000 m. However, Baird's beaked whales could be capable of diving as far down as 3,000 m and may hold their breath for an hour or longer. While diving, they generally feed between depths of 800-1,200 m on deep-sea and pelagic fish (e.g., mackerel, sardines, and saury), crustaceans, sea cucumbers as well as cephalopods. A sexually mature female will give birth to a single calf, usually between the months of March and April, after an estimated gestation period of 12-17 months. Females calve every 3 or more years (NMFS w).

Cuvier's beaked whale

Cuvier's beaked whales (*Ziphius cavirostris*) are distributed widely throughout deep waters of all oceans. Off the U.S. west coast, this species is the most commonly encountered beaked whale. No seasonal changes in distribution are apparent from stranding records, and morphological evidence is consistent with the existence of a single eastern North Pacific population from Alaska to Baja California, Mexico (Carretta et al., 2012).

Cuvier's beaked whales are typically found individually or in small groups from 2-12 animals, but groups of up to 25 animals have been reported. Like other beaked whales, they are deep divers. Cuvier's beaked whales are capable of diving up to at least 1,000 m for 20-40 minutes to opportunistically feed on mostly cephalopods and sometimes fish and crustaceans. Breeding and calving can apparently occur year round, but often during the spring. After a year-long gestation period, females give birth to a single calf every 2-3 years. They have an estimated lifespan of up to 60 years (NMFS w).

Killer whale

Killer whales (*Orcinus orca*) have been observed in all oceans and seas of the world. Although reported from tropical and offshore waters, they prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents. Killer whales occur along the entire west coast of North America, from Alaska to California, including inland waterways of British Columbia and Washington. Movements of whales between geographical areas have been documented. Pods have been labeled as 'resident', transient' and ‘offshore’ based on aspects of morphology, ecology, genetics and behavior. Offshore killer whales apparently do not mix with transient and resident killer whale stocks. The Eastern North Pacific Offshore stock, occurring from Southeast Alaska through California, is one of five killer whale stocks recognized within the Pacific U.S. EEZ (Carretta et al., 2012).

The gestation period for killer whales varies from 15-18 months, and birth may take place in any month. The birth rate for killer whales is not well understood, but, in some populations, is estimated as every 5 years for an average period of 25 years. The diet of killer whales is often geographic or population specific, and may include other marine mammals or fish (NMFS w).

<u>Mesoplodont beaked whales</u>
Mesoplodont beaked whales (*Mesoplodon* spp.) are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean. At least six species in this genus have been recorded off the U.S. west coast, but due to the rarity of records and the difficulty in identifying these animals in the field, virtually no species-specific information is available. Insufficient sighting records exist off the U.S. west coast to determine any possible spatial or seasonal patterns in the distribution of mesoplodont beaked whales (Carretta et al., 2012).

Mesoplodont beaked whales are usually found individually or in small social groups. Like other beaked whales, these whales are deep divers. While diving, they use suction to feed on small fish and cephalopods in deep water (NMFS w).

<u>Minke whale</u>
Northern Pacific minke whales (*Balaenoptera acutorostrata scammoni*) are usually seen over continental shelves. Those that are found from Washington to California appear to establish home ranges. The magnitude of the effects of entanglement in commercial gillnets and ship strikes on the population is unknown (Carretta et al., 2012).

The minke whale is the smallest baleen whale in North American waters. They are usually sighted individually or in small groups of 2-3, but there are reports of loose aggregations of up to 400 animals associated with feeding areas in higher latitudes. Minke whales feed by side-lunging into schools of prey as well as gulping large amounts of water. They opportunistically feed on crustaceans (e.g., krill), plankton (e.g., copepods), and small schooling fish. Mating and calving most likely takes place during the winter season. After a gestation period of 10-11 months, females give birth to a single calf. The reproductive interval for females is estimated at 14 months, but calving may occur annually. The estimated lifespan of these cetaceans may be up to 50 years (NMFS w).

<u>Dwarf and pygmy sperm whales</u>
Dwarf sperm whales (*Kogia sima*) and pygmy sperm whales (*Kogia breviceps*) are distributed throughout deep waters and along the continental slopes of the North Pacific and other ocean basins. Along the U.S. west coast, sightings of these species have been extremely rare. It is unclear whether this is because they are not regular inhabitants of this region or merely because of their cryptic habits (they are detected almost exclusively in extremely calm sea conditions), small body size, and offshore distribution. Despite the paucity of confirmed sightings, a handful of strandings suggest they are found offshore of the North American west coast. Available data are insufficient to identify any seasonality in the distribution of either of these species. No information is available to estimate the population size of dwarf sperm whales off the U.S. west coast (Carretta et al., 2012).

When these whales are seen, it is generally at the surface either alone or in small groups. They are likely capable of diving to at least 300 m to reach their prey, which consists of cephalopods (e.g., squid and octopus), crustaceans (e.g., shrimp and crabs), and fish. The estimated lifespan for this species may be up to 22 years (NMFS w).

Short-finned pilot whale

Short-finned pilot whales (*Globicephala macrorhynchus*) were once common off Southern California, but after a strong El Niño event in 1982-83, they virtually disappeared from this region. Approximately nine years later, they appeared to have returned, as indicated by an increase in sighting records as well as incidental fishery mortality. However, this cannot be considered a true growth in the population, because it merely reflects large-scale, long-term movements of this species in response to changing oceanographic conditions. It is not known where the animals went after the El Niño event, or where the more recently observed animals came from.

Although the full geographic range of the California, Oregon, and Washington population is not known, it may be continuous with animals found off Baja California, and morphologically distinct from short-finned pilot whales found farther south in the eastern tropical Pacific (Carretta et al., 2012).

Short-finned pilot whales often occur in groups of 25 to 50 animals. They feed primarily on squid, but they may also feed on octopus and fish, all from moderately deep waters of 300 m or more. When they are swimming, pilot whales form ranks that can be over a kilometer long. The calving interval is five to eight years, but older females do not give birth as often as younger females. Maturity occurs around 10 years of age and maximum longevity is 45 years for males and 60 years for females (NMFS w).

4.6.3 Northern Sea Otters

The northern sea otter (*Enhydra lutris kenyoni*) historically ranged throughout the North Pacific from Asia along the Aleutian Islands as far north as the Pribilof Islands, and in the Eastern Pacific from the Alaska Peninsula south along the coast to Oregon. Sea otters were extirpated from most of their range during the 1700s and 1800s as the species was exploited for its fur. Washington's sea otter population was extirpated by the early 1900s. The current Washington population originates from 59 sea otters that were captured at Amchitka Island, Alaska, and released off Washington's Olympic Peninsula coast in 1969 and 1970 (Carretta et al., 2012).

Sea otters are generally found in bays, lagoons, and estuaries and most commonly inhabit waters of less than 300 feet deep along the coast. The highest densities are found within the 130-foot isobath where young animals and females with pups forage. Otters dive for and consume large quantities of benthic invertebrates, including sea urchins, mussels, clams, chitons, and crabs. They tend to be non-migratory, moving relatively short distances between breeding and foraging areas. Sea otters are extremely susceptible to marine pollution as their fur must remain clean to maintain its insulative qualities, and they seldom leave the water (ADEC, 2008).

Sea otters breed and give birth year-round. Births in the Washington population are believed to occur primarily from March to April, with peak numbers of dependent pups present from May to September. Based on the 2007 survey (actual count), the minimum population estimate of the Washington sea otter population is 1,125 individuals. No correction factor for missed animals has been applied to count data to determine a total population estimate. This represents an average annual population increase of at least 8% since 1970. Sea otters are susceptible to drowning in gillnets, but an accurate estimate of annual mortality and serious injury due to this and other human hazards cannot be made due to lack of data (Carretta et al., 2012).

The Washington sea otter stock is not listed as "depleted" under the MMPA nor listed under the ESA. However sea otters are listed by the State of Washington as "State endangered" due to small population size, restricted distribution, and vulnerability.

SECTION 5.0

POTENTIAL IMPACTS OF DISCHARGE ON MARINE ORGANISMS AND HUMAN HEALTH

This section of the ODCE addresses three of the ten criteria listed in Section 1.0 that must be considered in determining whether there is potential for "unreasonable degradation" of the marine environment related to a point-source discharge. As discussed earlier and for the purposes of this section, "unreasonable degradation" is defined as:

1. Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities;
2. Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms.
3. Loss of aesthetic, recreational, scientific, or economic values, which are unreasonable in relation to the benefit derived from the discharge.

The three criteria to be considered in this section are:

- Criterion # 1: The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged
- Criterion # 2: The potential transport of such pollutants by biological, physical, or chemical processes
- Criterion # 6: The potential impacts on human health through direct or indirect pathways

The potential adverse effects of seafood processing waste include direct and indirect impacts of the solid and liquid waste discharges to marine organisms. Solid wastes consist of unused portions of the fish that have been processed and may include heads, skin, scales, viscera, and fins discarded during cleaning and butchering. Liquid wastes include soluble organic matter and nutrients leached from fish during processing. The liquid wastes may also include waste from process disinfectants, sanitary wastes, and other wastewaters (i.e., cooling water, boiler water, gray water, freshwater pressure relief water, refrigeration condensate, water used to transfer seafood to the facility, and live tank water). Both solid and liquid waste discharges are proposed by the Draft Permit.

Potential direct impacts of solid waste discharges include waste accumulation on the seafloor. This could alter the benthic community due to burial, the sediment texture, and chemical changes effected within the sediments due to the decay of organic matter accumulations. The decay of accumulations of solid waste may also result in depletion of dissolved oxygen in the overlying water column and releases of potentially toxic decay byproducts like unionized ammonia and undissociated hydrogen sulfide. Nutrients (particularly nitrogen and phosphorus) are also released during the decay of solid waste which may result in eutrophic conditions and subsequent shifts in both phytoplankton community abundance and structure.

The solid waste discharge may also result in water column turbidity which has the potential to decrease photosynthetic production by phytoplankton. Potential direct impacts of liquid wastes include depletion of dissolved oxygen in the water column due to the decay of soluble oxygen demanding substances in the wastewater. Residual concentrations of chlorine disinfectants in the liquid waste stream and additional oxidants produced by the reactions of chlorine with other compounds could potentially impact marine organisms.

Potential indirect impacts of seafood waste discharges involve effects on marine mammals and birds due to their attraction to seafood waste discharges. The attraction of marine mammals to seafood waste discharges may make them easier prey for predators. Birds that are attracted to surface plumes of seafood waste may become oiled due to accumulation of waste fish oils on the water surface. Another potential indirect impact involves the development of dependence on an anthropogenic food supply that may result in concentration and growth of marine mammal and bird populations that could be adversely affected if this food supply was reduced or eliminated. Eutrophication of marine waters may also result in enhancement of phytoplankton species that are toxic to marine organisms and humans. Bacteria associated with the decaying seafood waste may also adversely impact marine mammals and birds.

Although a number of potential impacts to marine organisms are outlined above, no known studies specific to seafood processing waste discharges have been conducted to assess the importance of the direct and indirect impacts in offshore waters. Most studies conducted to date have focused on the direct effects from shorebased seafood processing plants of solid waste accumulations on benthic organisms, the effect of decaying waste on water column dissolved oxygen concentrations, and the potential toxic effect of waste decay byproducts (i.e., unionized ammonia and undissociated hydrogen sulfide) on marine organisms.

The potential direct and indirect impacts of seafood waste discharges are discussed in more detail below. Information specific to seafood processing waste discharges is reviewed and summarized where possible. Literature relevant to potential impacts associated with eutrophication and residual chlorine are from studies conducted on other types of waste discharges (e.g., municipal wastewater facilities), since studies specific to seafood processing wastes are not available. Most of the discussion of the potential indirect impacts of seafood processing discharges relies on personal communications from scientists and regulatory agency personnel familiar with seafood processing in Alaska.

5.1 IMPACTS ASSOCIATED WITH SOLID SEAFOOD PROCESS WASTES

During discharge of seafood processing waste, biological impacts are most likely to occur as a result of the discharge of seafood waste particulates (both direct and indirect effects). The following discussion briefly presents the different potential effects of discharges on biota including burial and habitat modification, the alteration of sediment composition, and the chemistry associated with the decomposition of the waste solids.

5.1.1 Burial and Habitat Modification

Disposal of seafood waste solids will have the greatest impact on less mobile benthic organisms such as polychaetes and bivalves, and on demersal fish eggs that cannot move away from the accumulating waste.

The degradation of this organic material occurs at varying rates according to different characteristics of the discharge area (i.e. biological, physical, and chemical factors). The accumulation of these deposits in areas indicates that the rate of discharge exceeds the assimilation capacity of some water bodies and more specifically, the assimilation capacity of the benthic community and other aquatic life that metabolize this material. The facilities covered by the Draft Permit are constantly moving and discharging in areas with high tidal activity that will ensure dispersion and dilution of the seafood wastes and minimize accumulation of these deposits in one area. If discharge limits are adhered to, the effects on aquatic biota in areas of seafood processing waste discharge should be minimal.

5.1.2 Effects of Deposited Solids

Many benthic invertebrates are relatively sedentary and sensitive to environmental disturbance and pollutants. Short- and long-term effects of seafood waste on benthic invertebrates can include smothering of biota, especially by ground particulates in the area near the discharge. Deposition is likely to reduce and possibly eliminate abundances of infaunal benthos such as polychaetes, mollusks, and crustaceans, and may affect demersal eggs of various benthic species and fish.

Little information is presently available concerning the direct effects of various deposition depths on benthic communities. Most studies that have investigated deposition impacts on benthos have examined deposition of dredged materials (Hale 1972; Kranz 1974; Mauer et al. 1978; Oliver and Slattery 1973; Saila et al. 1972; Schafer 1972; Wilber 1992). These studies indicate that the response to deposition and survival following such an event is species specific. Of the species examined, burial depths from which organisms were able to migrate to the surface ranged from 0.4 to 12.6 in (1 to 32 cm). If it is assumed that most benthos are not adversely affected by loose deposition of seafood waste less than 0.4 in (1 cm), benthos in the vicinity of the discharge receiving deposition in excess of this amount are likely to be adversely impacted. Seafood solids are highly organic material and the decomposition of this material may lead to other impacts on benthos related to localized depression of dissolved oxygen.

A number of important species release demersal eggs. As with other types of fish eggs, demersal eggs require oxygen for development. Seafood waste discharges resulting in waste excess accumulation are typically anoxic due to decay and decomposition of the waste. Thus, demersal eggs could be smothered if located beneath a discharge. Such smothering of demersal eggs could have a substantial adverse impact on these demersal species and other aquatic organisms that prey upon these fish. Seafood wastes that are discharged during spawning and egg production periods have the most potential to adversely affect these species. Offshore seafood operations are unlikely to adversely impact demersal fish spawning activities because spawning grounds are more commonly found in nearshore waters. A number of studies have been conducted regarding effects of suspended solids on egg mortality, but the effect of waste deposition on egg mortality is not well documented (USEPA 1984b). In particular, it is not known at what depth of deposition egg survival would be impaired. However, it is reasonable to conclude that impairment may occur at fairly shallow waste depths (e.g., 0.4 in) if that depth of waste was sufficient to impair oxygen transfer to the egg or if anoxic conditions were present.

Since facilities discharging under the Draft Permit should not create piles nor mats of organic waste, and any potential accumulation should be less than 0.2in (0.5cm) it is unlikely adverse conditions will be present.

5.1.3 Alteration of Sediment

Alteration of sediment characteristics would be expected to impact the benthic community structure more subtly, but at greater distances from the point of discharge, than smothering. Benthos would be the group of organisms most affected by changes in the sediment, but other organisms may be affected as well; impacts to benthic communities could also conceivably affect epibenthic and pelagic invertebrates, fish, birds, and mammals that rely on benthic invertebrates for food.

The general changes in benthic community structure and function that occur under conditions of increasing organic enrichment of the sediments (such as occurs as a result of stationary seafood waste discharges or municipal sewage effluent discharges) have been well documented (Pearson and Rosenberg 1978 and Germano & Associates 2004). Slight to moderate enrichment results in slight increases in numbers of individuals and biomass of benthic communities, while species composition remains essentially unchanged. As enrichment increases, the overall abundance of benthic organisms increases. However, there is a corresponding decrease in the number of species as the less tolerant species are eliminated. In more extreme cases, only a relatively small number of species adapt to disturbed environments and/or high organic content become very abundant. When the enrichment levels are optimal for those few species, they become extremely abundant, and overwhelmingly dominate the benthic community. Biomass generally decreases as many of these opportunistic species are very small.

These changes in benthic community variables are accompanied by a progressive reduction in the depth of the oxygenated surficial sediment layer, and changes in the predominant trophic groups of benthic organisms. Mixed assemblages, or assemblages dominated by suspension feeders, are first replaced by assemblages dominated by surface deposit feeders, and then replaced by assemblages dominated by subsurface deposit feeders. Under very highly enriched conditions, the sediments become anoxic and macrobenthic organisms may be entirely absent.

It is assumed that a short term, slight to moderate, increase of organic enrichment may be present just after discharge. However, because facilities should not be creating piles or mats of organic wastes, changes in the benthic community is not anticipated.

5.1.4 Decay of Solid Wastes

The decay of organic matter accumulations can effect chemical changes within the sediments and may lead to anoxic conditions within a pile or mat of organic waste. The decay of solid waste accumulations may also result in depletion of dissolved oxygen in the overlying water column and releases of potentially toxic decay byproducts like unionized ammonia and undissociated hydrogen sulfide. Again, benthic communities and demersal eggs would be directly adversely affected by anoxic conditions within the accumulated organic waste. Most infauna would either migrate out of the area or be killed as a result of the lack of oxygen. Anoxic conditions are expected to destroy any demersal eggs that might be present. A few species may be able to survive within the thin upper sediment layer of the waste pile (e.g., *Capirella* spp.).

Since ambient waters containing abundant dissolved oxygen rapidly mix with the affected waters, reductions of dissolved oxygen concentrations throughout the overlaying water column are not expected, nor are significant impacts to mobile marine organisms. Areas of reduced dissolved oxygen, if any, would be expected to be small and would be avoided or quickly passed through by mobile organisms.

5.2 EXPOSURE TO SUSPENDED SOLIDS

As discussed in Section 3.0, deposition of the majority of discharged solids is expected to be rapid and localized. Therefore, adverse physical effects to biota from ground seafood discharge should be limited to the nearfield vicinity of the outfall. Within this region, zooplankton and fish larvae near the discharge may experience altered respiratory or feeding ability due to stress, or clogging of gills and feeding apparatus. Phytoplankton entrained in the discharge plume may have reduced productivity due to decreased light availability. However, such potential impacts may be offset in the farfield by increases in nutrient concentrations. These impacts should result in negligible impacts to populations in the region, as impacts should be restricted to the immediate vicinity of the discharge. Mobile invertebrates, fish, birds, and mammals presumably will avoid the discharge plume if conditions become stressful. However, biota may also be attracted to the discharge plume to feed on the discharged particulates. Secondary impacts associated with attraction are discussed in Section 5.3. Infaunal or sessile organisms near the discharge are not likely to be impacted by the suspended solids.

In addition to potential chemical and physical alterations of the water column and benthos, seafood processing residues can cause some aesthetic and physical effects on the water surface that could impair existing or designated uses. In addition, seafood processing residues can form a surface layer of scum, foam, or fine particles that could present a physical barrier preventing dissolved oxygen re-aeration, block light to the water column, deter avian feeding, and create an aesthetically undesirable condition. Such effects could also attract nuisance species and unwanted predators that would impair beneficial uses. The Draft Permit proposes to prohibit facilities from discharging wastewaters that contain substances that float as debris, scum, oil, or other matter to form nuisances. The Draft Permit also prohibits the discharge of seafood processing wastes that create an attractive nuisance situation whereby fish or wildlife are attracted to waste disposal or storage areas in a manner that creates a threat to fish or wildlife or to human health and safety. If an operator complies with the Draft Permit conditions, these prohibition would limit such concerns under normal operating conditions.

5.3 IMPACTS ASSOCIATED WITH LIQUID SEAFOOD PROCESSING WASTE

Liquid seafood processing discharges include two waste streams, one directly associated with the seafood waste and the other associated with ancillary operations whose wastewaters do not come in contact with seafood waste. The seafood processing discharges contain solid and soluble materials that include soluble oxygen demanding substances (i.e., BOD), nutrients, and oil and grease. These discharges may also contain disinfectants including ammonia and chlorine which may produce direct toxic effects. Liquid discharges that are not directly associated with seafood processing activity and that do not come into direct contact with seafood waste (e.g., bailwater, cooling water, boiler water, etc.) are generally not expected to impact marine organisms because they are considered to be non-toxic, do not contain significant amounts of oxygen demanding substances and nutrients, or in the case of soluble sanitary wastes, are treated prior to discharge. The potential impacts to marine organisms due to the discharge of substances with elevated BOD, nutrients, and disinfectants are discussed below. Chemicals that are considered bioaccumulative or persistent are not known to be present in seafood processing waste discharges.

5.3.1 BOD / Dissolved Oxygen

Wastes discharged from seafood processing facilities include relatively high concentrations of BOD. Bacterial oxidation of the soluble organic matter in these wastes results in the consumption of water column dissolved oxygen. Aquatic organisms require adequate dissolved oxygen to survive. The term “dead zone” is often used in reference to the absence of life (other than bacteria) in habitats that are devoid of oxygen. The inability to escape low oxygen areas makes immobile species, such as oysters and mussels, particularly vulnerable to hypoxia. These organisms can become stressed and may die due to hypoxia resulting in significant impacts on marine food webs and the economy. Mobile organisms can flee the affected area when dissolved oxygen becomes too low. Nevertheless, fish kills can result from hypoxia, especially when the concentration of dissolved oxygen drops rapidly (CENR, 2010).

In general, offshore waters are well oxygenated and provide a considerable buffer for the assimilation of soluble organic wastes. In areas of restricted circulation or relatively low ambient dissolved oxygen concentrations resulting from natural processes, the potential for adverse effects on marine organisms from depletion of dissolved oxygen is increased. Nonetheless, ground seafood discharges to well-oxygenated open offshore coastal waters will not likely result in adverse effects from dissolved oxygen depletion.

5.3.2 Nutrients and Dissolved Oxygen

Excessive nutrients can cause a multitude of problems in coastal areas including eutrophication, harmful algal blooms, fish kills, shellfish poisonings, loss of seagrass and kelp beds, coral reef destruction, and reduced DO. As stated above, nitrogen is a common pollutant found in seafood processing waste. Nitrogen is known to be particularly damaging to bays and coastal seas by boosting primary production (the production of algae). With excessive amounts of nitrogen, the growth of algae and denitrifying bacteria increases making the water more turbid. As the algae die and decompose, dissolved oxygen is depleted from the surrounding water if there is insufficient mixing or other re-aeration mechanisms present (Howarth et al., 2000; Novatec, 1994). High levels of living algae can also lead to depletions in oxygen over the nighttime hours due to their oxygen consumption during this time period. Low dissolved oxygen levels can cause direct mortality of organisms, or reduced efficiency of physiological processes (e.g. food processing, growth). These changes in nutrients, light, and oxygen favor some species over others causing shifts in phytoplankton, zooplankton, and benthic communities (Howarth et al. 2000). In particular, animals that rely directly or indirectly on seagrass beds could be affected by algal blooms caused by excessive nutrients.

Unlike solid residues, nutrients are water soluble and can therefore be transported beyond areas of deposition unless assimilated by aquatic life, sorbed to sediments, or released to the atmosphere (denitrification and volatilization of nitrogen). Insufficient dilution or mixing of transported nutrients could conceivably affect other locations.

The discharges proposed by the Draft Permit are from constantly moving vessels in areas of good flushing, reducing the likelihood of accumulating excess amounts of nutrients and adversely effecting water quality.

5.3.3 Enhanced Productivity

Because phytoplankton form the base of the food chain, impacts to the phytoplankton community could have significant effects on the marine ecosystem as a whole (Legendre 1990). Although enhanced phytoplankton growth would not necessarily be an adverse effect since phytoplankton form the base of the marine food chain, a large increase in phytoplankton standing crop or changes in species composition, particularly to toxic species, could have adverse effects on dissolved oxygen concentrations, aesthetic water quality, other marine organisms, and humans.

Several factors control the rate of phytoplankton productivity and the accumulation of algal biomass. These include temperature, light intensity, mixing depth, and the supply of other nutrients such as nitrogen, phosphorus, silica, and a number of other essential elements (e.g., iron, manganese, zinc, copper, and cobalt). Other factors influencing phytoplankton productivity and biomass that are still poorly understood include inhibitory and stimulatory substances such as vitamin B_{12} and chelating agents (Aubert 1990; United Nations 1990). Factors influencing changes in phytoplankton community composition are also poorly understood, but are generally related to adaptations of certain species to specific combinations of the factors identified above. For example, diatoms (a group of marine and freshwater algae) appear to be favored when available nutrient concentrations (especially silica) are high and turbulent water column mixing is adequate to maintain these algae in the upper water column layer where light is available. An additional factor that controls the biomass and species composition of phytoplankton is the grazing activity of zooplankton that may feed selectively on certain species of phytoplankton.

The potential for adverse impacts of nutrient discharges from seafood processing facilities would depend on whether the amount of nitrogen or phosphorus available limit phytoplankton growth in the vicinity of the discharge, or if other influencing factors contained in the waste discharge could significantly influence phytoplankton production. Other relevant factors to consider include water exchange, mixing depth, zooplankton grazing activity, and the depth of light penetration in the water column. These variables make it difficult to predict the potential impact of nutrient rich waste discharges from seafood processors on marine phytoplankton communities. However, impacts would most likely occur in relatively shallow areas of restricted water circulation where nitrogen or phosphorus limitation of phytoplankton growth occurs. Therefore, discharges to the relatively well-flushed offshore coverage area of the Draft Permit have a lower potential to cause enhanced phytoplankton growth and biomass.

The Draft Permit specifies that the discharge flow shall not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life. The requirement ensures minimum impact of nutrient rich wastes on phytoplankton communities.

5.3.4 Alterations in Phytoplankton Species Composition/Toxic Phytoplankton

Alterations in phytoplankton species composition is another potential impact of nutrient rich discharges on marine phytoplankton. Concerns regarding alterations in phytoplankton community composition are related to indirect effects resulting from increasing the populations of phytoplankton species that may produce adverse effects on marine organisms and humans. Effects produced by some phytoplankton species include physical damage to marine organisms (e.g., diatom species of *Chaetoceros* that have caused mortality of penned salmon), toxic effects to marine organisms (e.g., a raphidophyte flagellate species of *Hererosigma*), and toxic effects to humans due to the concentration of algal toxins in marine fish and shellfish [e.g., Paralytic Shellfish Poisoning (PSP), Diarrheic Shellfish Poisoning, Neurotoxic Shellfish Poisoning, Amnesic Shellfish Poisoning, and ciguatera] (Taylor 1990; Haigh and Taylor 1990).

Concerns regarding toxic phytoplankton have been heightened in recent years due to suspicions that the frequency of toxic phytoplankton blooms has increased due to human activities, especially due to agricultural runoff and the discharge of municipal and industrial wastewater to marine coastal areas (Smayda 1990; Smayda and White 1990; United Nations 1990; Anderson 1989).

Several studies in other parts of the US have linked mortalities of relatively large numbers of marine mammals (e.g., O'Shea et al. 1991; Anderson and White 1989; Geraci 1989; Geraci et al. 1989; Gilmartin et al. 1980), fish and shellfish (e.g., Cosper et al. 1990; Smayda and Fofonoff 1989), and aquatic plants (e.g., Cosper et al. 1990) to the occurrence of toxic phytoplankton. PSP is caused by the consumption of shellfish that have concentrated toxins from an algae of the species *Protogonyaulax* (Shimizu 1989); however, direct links between the occurrence of PSP and eutrophication have not been established (Anderson 1989). Therefore, the linkage between PSP and seafood processing discharges, while possible, is tenuous.

Although there is a potential for the discharge of seafood processing waste to cause localized changes in phytoplankton species composition, there are no known studies to indicate that discharges of seafood processing wastes have produced toxic or harmful phytoplankton blooms. The discharges authorized by the Draft Permit are at least 3 nm from shore, with high rapid mixing and high levels of dilution, therefore, impacts nearshore to shellfish would be unlikely. Similarly, while PSP has been documented in Washington and Oregon, there is currently no evidence suggesting a linkage with seafood processing discharges. Additionally, the Draft Permit specifies that the discharge shall not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life. This requirement ensures minimum impact of nutrient rich wastes on phytoplankton communities.

5.3.5 Disinfectants/Residual Chlorine

Soluble wastes from seafood processing discharges may contain residual concentrations of chlorine, iodine, or ammonia based disinfectants. Chlorine based disinfectants are the most commonly used. Residual chlorine and chlorine-produced oxidants have been shown to be toxic to marine organisms at relatively low concentrations (USEPA 2002; Thatcher 1980). Thatcher (1980) conducted 96-hr LC_{50} (lethal concentration for 50% mortality) continuous-flow bioassays on a number of species of fishes and invertebrates typical of the Pacific Northwest and determined that juvenile species of salmon were particularly sensitive. The lowest LC_{50} determined for coho salmon was 32 µg/L.

The Draft Permit does not include a chlorine limit, nor a limit for any other disinfectant, but does require the development of a best management practice (BMP) Plan. The BMP Plan specifically requires that the facility include measures to minimize the use of toxic disinfectants where applicable. Disinfectants should dissipate rapidly and would not be expected to degrade the receiving water quality.

5.4 SECONDARY IMPACTS

Potential secondary impacts of seafood waste discharges involve effects on marine mammals, fish, and birds due to their attraction to seafood waste discharges. Bacteria associated with the decaying seafood waste may also adversely impact marine mammals and birds. The potential indirect impacts resulting from eutrophication of marine waters were discussed in Section 5.3.4.

5.4.1 Attraction of Organisms to the Discharge

The attraction of marine mammals to seafood waste discharges may make them easier prey for predators. Loughlin and York (2000) cited that discharges from offshore seafood processing facilities attract both steller sea lions and killer whales resulting in increased predation above natural levels, although actual increases in mortality has not be accurately quantified.

Seafood waste discharges can increase localized populations of gulls and parasitic birds which may adversely affect the breeding success of some bird species. Similarly, Reed and Flint (2007) cite the correlation of eiders attracted to an area with seafood processing with increased predation by eagles. The Draft Permit prohibits the discharge of seafood processing wastes which create an attractive nuisance situation whereby fish or wildlife are attracted to waste disposal or storage areas in a manner that creates a threat to fish or wildlife or to human health and safety.

Another potential secondary impact involves the development of dependence on an anthropogenic food supply that may result in the concentration and growth of populations of marine mammal and birds that could be adversely affected with a reduction or elimination of this food supply.

Birds that are attracted to surface plumes of seafood waste (especially floating particulates) may potentially become oiled or their feathers fouled if there is an accumulation of waste fish oils on the water surface. Unless the volume of floating oils was significant and the birds were constantly diving through it, it is unlikely that fouling of the feathers would occur. The Draft Permit requires that all receiving waters be free from floating material such as debris, scum, oil or other matter that forms a nuisance on the surface of the water. Assuming plant operators comply with this provision, oils associated with the discharges should not be a significant concern.

5.5 SUMMARY

The potential adverse effects of seafood processing waste include direct and indirect impacts of the solid and liquid waste discharges to marine organisms. Potential direct impacts of solid waste discharges, including burial and habitat modifications, alteration of sediments, and other associated issues with the accumulation of waste on the seafloor are highly unlikely. The Draft Permit requirement that discharges be located in areas of high current activity should minimize the potential accumulation of seafood processing wastes. Discharges of ground seafood waste that comply with Draft Permit limitations are not expected to cause adverse effects on marine organisms nor human health.

Eutrophication of coastal marine waters is not expected to occur in locations where water exchange is adequate to dilute nutrient inputs from seafood processing waste discharges. Residual concentrations of chlorine disinfectants in the liquid waste stream and additional oxidants produced by the reactions of chlorine with other compounds, are expected to be low due to the nature of the treated discharge, amount of dilution, and rapid dispersion.

Eutrophication of marine waters may also indirectly result in enhancement of phytoplankton species that are toxic to marine organisms and humans. Although toxic phytoplankton species occur in marine waters, there is no known evidence to date establishing a link between the occurrence of toxic phytoplankton and offshore seafood processing waste discharges.

The attraction of marine mammals and birds to seafood processing waste discharges has the potential to create indirect impacts. It is anticipated that restrictions and limitations included in the Draft Permit will diminish these types of potential impacts.

SECTION 6.0

THREATENED AND ENDANGERED SPECIES

6.1 INTRODUCTION

The determination of "unreasonable degradation" of the marine environment is to be made based upon consideration of the ten criteria listed in Section 1.0. This section provides information pertinent to consideration of the criterion listed below:

- Criterion #3: "The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain"
-

Section 7(a)(2) of the ESA requires federal agencies, in consultation with the agencies responsible for administering the ESA (the NMFS and the USFWS) to ensure that any action they authorize is not likely to jeopardize the continued existence and recovery of any species listed as threatened or endangered or result in the destruction or adverse modification of critical habitat. The ESA defines an "endangered species" as a species that is in danger of extinction throughout all or a significant portion of its range. A "threatened species" is defined as a species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

The threatened and endangered species list, was obtained from the NOAA website and updated April 24, 2015. The list is summarized in the table below and subsequently discussed in detail are included because of their potential presence within portions of the area covered by the Draft Permit. The information on these species is the same as that presented in the Biological Evaluation for this Draft Permit.

Table 6.1 ESA Listed Species Potentially Occurring within the Action Area

Species or Population	Status[3]
Marine Mammals (8)	
Guadalupe fur seal	T
Blue whale	E
Finback whale	E
Humpback whale	E
Killer whale (Southern Resident DPS)	E
North Pacific right whale	E
Sei whale	E
Sperm whale	E
Fish (33)	
Bocaccio	E
Canary rockfish	T
Yelloweye rockfish	T
Pacific eulachon	T
Chinook salmon - CA coastal	T

Species or Population	**Status[3]**
Chinook salmon - Central Valley spring-run ESU[2]	T
Chinook salmon - Lower Columbia River ESU	T
Chinook salmon - Puget Sound ESU	T
Chinook salmon - Sacramento River winter-run ESU	E
Chinook salmon - Snake River fall-run ESU	T
Chinook salmon - Snake River spring/summer-run ESU	T
Chinook salmon - Upper Columbia spring-run ESU	E
Chinook salmon - Upper Willamette River ESU	T
Chum salmon - Columbia River ESU	T
Chum salmon - Hood Canal summer-run	T
Coho salmon - Central California Coast ESU	E
Coho salmon - Lower Columbia River ESU	T
Coho salmon - Oregon Coast ESU	T
Coho salmon - Southern Oregon/Northern California Coasts ESU	T
Sockeye salmon - Ozette Lake ESU	T
Sockeye salmon - Snake River ESU	E
Steelhead - Central CA coast	T
Steelhead - Central Valley CA	T
Steelhead - Lower Columbia River	T
Steelhead - Middle Columbia River	T
Steelhead - Northern California	T
Steelhead - Puget Sound	T
Steelhead - Snake River Basin	T
Steelhead - South central CA coast	T
Steelhead - Southern CA coast	E
Steelhead - Upper Columbia River Basin	T
Steelhead - Upper Willamette River	T
North American green sturgeon	T
Birds (2)	
Marbled murrelet	T
Short-tailed albatross	E
Turtles (4)	
Green sea turtle	T
Leatherback sea turtle	E
Loggerhead sea turtle	T
Olive ridley sea turtle	T

[1]DPS = Distict Population Segment, which is a population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of species.

[2]ESU = Evolutionarily Significant Unit, which is similar to a DPS but used mainly for fish.

[3]E = Endangered, T = Threatened

In addition to listing species under ESA, the critical habitat of a newly listed species must be designated, concurrent with its listing, to the "maximum extent prudent and determinable" (16 U.S.C. § 1533[b][1][A]). ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. Federal agencies are prohibited from undertaking actions that destroy or adversely modify designated critical habitat. Some species, primarily the cetaceans, which were listed in 1969 under the Endangered Species Conservation Act and carried forward as endangered under ESA, have not received critical habitat designations. Figure 6.1 shows critical habitats that lie in or near the Draft Permit action area.

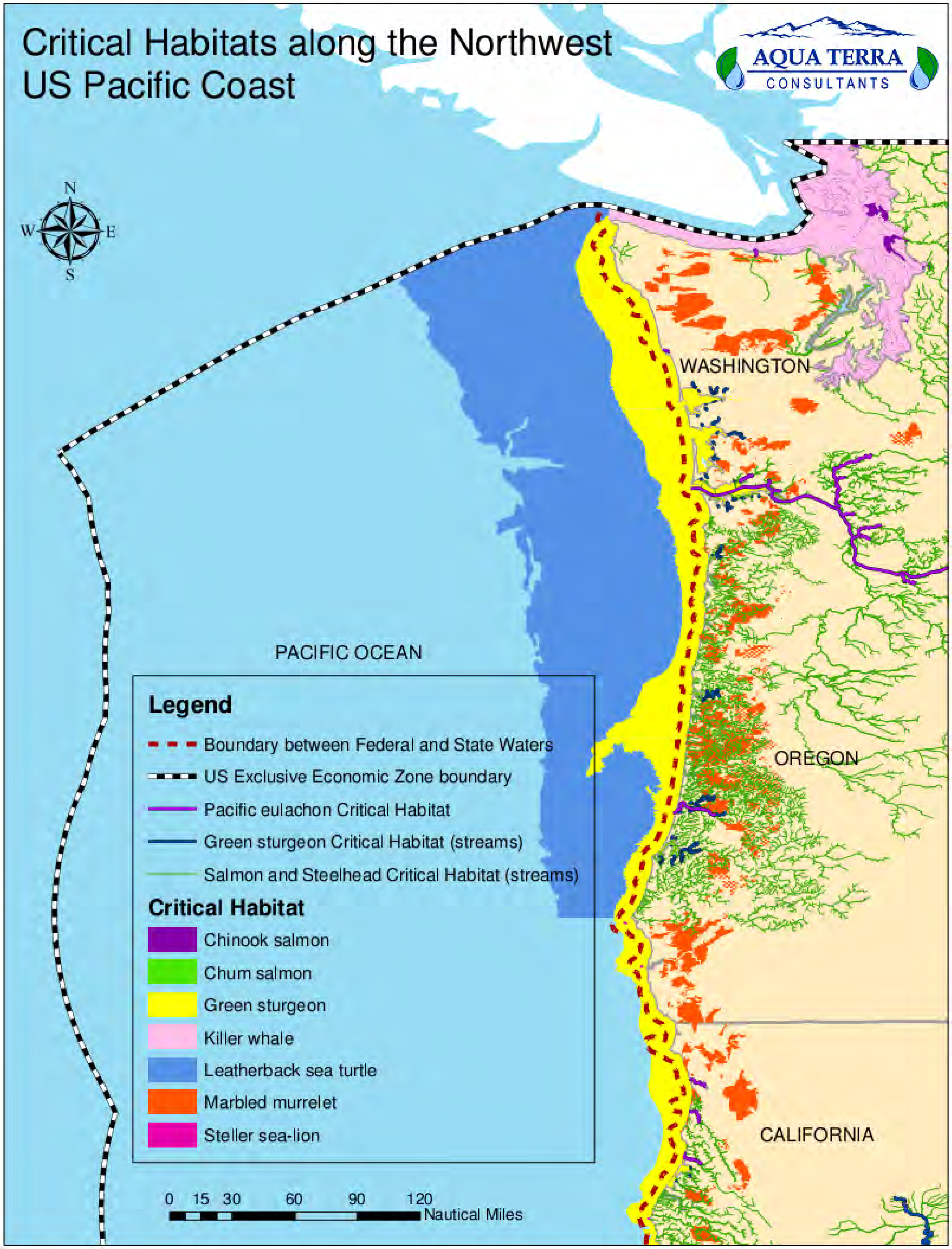

Figure 6.1 Critical Habitat for Species Occurring off the Pacific Coasts of Washington and Oregon

6.2 THREATENED AND ENDANGERED MARINE MAMMALS

6.2.1 Guadalupe fur seal

The Guadalupe fur seal (*Arctocephalus townsendi*) was listed as threatened throughout its range on December 16, 1985 (50 FR 51252).

6.2.1.1 Species range

Guadalupe fur seals reside in the tropical waters of the Southern California/Mexico region. During breeding season, they are found in coastal rocky habitats and caves. Little is known about their whereabouts during the non-breeding season (May to September). Guadalupe fur seals are non-migratory and their breeding grounds are almost entirely on Guadalupe Island, Mexico. There are small populations off of Baja California on San Benito Island and off of Southern California at San Miguel Island. A range map for this species is shown in Figure 6.2 (NMFS a).

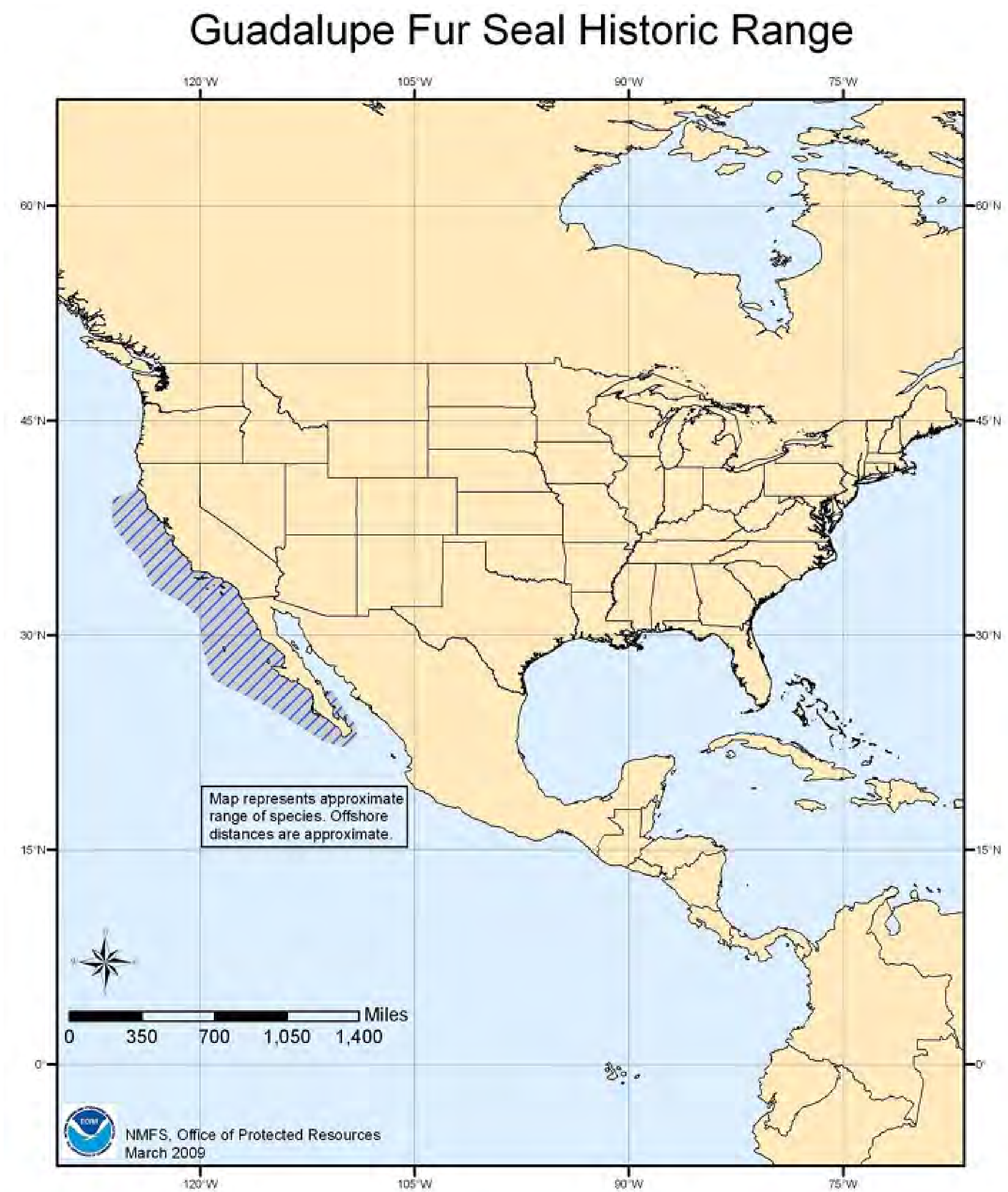

Figure 6.2 Guadalupe Fur Seal Range (Source: http://nmfs.noaa.gov)

6.2.1.2 Critical habitat

No critical habitat rules has been designated for the Guadalupe Fur seal.

6.2.1.3 Life history and ecology
Guadalupe fur seals are solitary, non-social animals. Males are "polygamous" and may mate with 4 to 12 females during a single breeding season. Males form small territories that they defend by roaring or coughing. Breeding season is June through August, with females arriving in early June; pups are born a few days after their arrival. A female will mate about a week after giving birth to her pup. Weaning occurs around 9 months. Guadalupe fur seals feed mainly at night on squid, mackerel, and lantern fish by diving up to depths of 65 ft (20 m) (NMFS a).

6.2.1.4 Population trends and risks
The Guadalupe fur seal population is slowly recovering from the brink of extinction. The current population abundance is approximately 10,000 animals. Of all the fur seal species, this one is the least studied due to their limited geographic locations. The Guadalupe fur seal population is increasing about 13.7% annually. In the 1700s and 1800s, commercial sealers heavily hunted Guadalupe fur seals to the point where the species was thought to be extinct by the early 1900s. Insufficient data exist on the incidental bycatch of Guadalupe fur seals in fishing gear, although some juvenile seals have been documented with entanglement injuries (NMFS a).

6.2.2 Blue whale
The blue whale (*Balaenoptera musculus*) was included in the first list of endangered species under the Endangered Species Conservation Act, the precursor to the ESA, on June 2, 1970 (35 FR 8491).

6.2.2.1 Species range
Blue whales are found in oceans worldwide. The blue whale's range is known to encompass much of the North Pacific Ocean, from Kamchatka to southern Japan in the west, and from the Gulf of Alaska south to at least Costa Rica in the east. The species is found primarily south of the Aleutian Islands and the Bering Sea (Reeves et al., 1998).

6.2.2.2 Critical habitat
No critical habitat has not been designated for the Blue whale.

6.2.2.3 Life history and ecology
It is assumed that blue whale distribution is governed largely by food requirements and that populations are seasonally migratory. Poleward movements in spring allow the whales to take advantage of high zooplankton production in summer. Movement toward the subtropics in the fall allows blue whales to reduce their energy expenditure while fasting, avoid ice entrapment in some areas, and engage in reproductive activities in warmer waters of lower latitudes. This species inhabits and feeds in both coastal and pelagic environments (Reeves et al., 1998).

6.2.2.4 Population trends and risks
It is estimated that there were about 1,500 blue whales in the North Pacific when modern commercial whaling began in the early 1900s. Current estimates are in the low hundreds (Reeves et al., 1998).

Whaling has caused the largest reductions in this species population, but other factors might also contribute to its decline or may prevent the population’s recovery. These factors include collisions with ships, disturbance by commercial and recreational vessels, entanglement in fishing gear, habitat degradation, and aquatic pollution. Little evidence exists to support the conclusion that any of these factors caused a serious decline in the blue whale population, but these factors may prevent the recovery of the species (Reeves et al., 1998).

6.2.3 Finback whale

The fin whale (*Balaenoptera phyusalus*) has been listed as “endangered” since 1970 under the precursor to the Endangered Species Act (ESA) and has remained on the list of endangered species since the ESA was passed in 1973 (35 FR 8491).

6.2.3.1 Species range

Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes, and less commonly in the tropics.

Fin whales are migratory, moving seasonally into and out of high-latitude feeding areas, but the overall migration pattern is complex. Fin whales can occur in any one season at many different latitudes, perhaps depending on their age or reproductive state as well as their “stock” affinity. Movements can be either inshore/offshore or north/south. There may be resident groups of fin whales in some areas, including the Gulf of California (NMFS, 2010).

6.2.3.2 Critical habitat

Critical habitat has not been designated for the fin whale.

6.2.3.3 Life history and ecology

Fin whales are large, fast swimmers and the killer whale is their only non-human predator. During the summer, Pacific fin whales feed on krill, small copepods, and small schooling fish (e.g., herring, walleye pollock, and capelin). Fin whales fast in the winter while they migrate to warmer waters.

Most reproductive activity, including mating and births, takes place in the winter season (November to March; peak December/January). The gestation period is probably somewhat less than a year, and fin whale calves are nursed for 6–7 months. The average calving interval has been estimated at about two years (NMFS, 2010).

6.2.3.4 Population trends and risks

Although reliable and recent estimates of fin whale abundance are available for large portions of the North Atlantic Ocean, this is not the case for most of the North Pacific Ocean or for the Southern Oceans. The present status of populations in these ocean basins relative to their pre-whaling population size is uncertain. There are currently believed to be tens of thousands of fin whales worldwide.

NMFS recognizes three stocks in U.S. Pacific waters: Alaska (Northeast Pacific), California/Oregon/Washington, and Hawaii. The California/Oregon/Washington stock was estimated at 2,636 fin whales based on ship surveys conducted in summer/autumn of 2001 and 2005.

Historically, the greatest threat to the fin whale was commercial whaling, which ended in the North Pacific Ocean in 1976, in the Southern Ocean in 1976-77, and in the North Atlantic Ocean in 1987. They are still hunted in Greenland and subject to catch limits under the International Whaling Commission (IWC)’s “aboriginal subsistence whaling" provisions. Iceland resumed commercial whaling of fin whales in 2006 under a formal objection to the IWC’s ban on commercial whaling and Japan kills fin whales as part of its scientific whaling program. Among the current potential threats are collisions with vessels, reduced prey abundance due to overfishing and/or climate change, the possibility that illegal whaling or resumed legal whaling will cause removals at biologically unsustainable rates and, possibly, the effects of increasing anthropogenic ocean noise (NMFS, 2010).

6.2.4 Humpback whale
The humpback whale (*Megaptera novaeangliae*) was designated as endangered throughout its entire range on the first list of endangered species under the Endangered Species Conservation Act on June 2, 1970 (35 FR 8491).

6.2.4.1 Species range
Humpback whales live in all major oceans from the equator to sub-polar latitudes. In the North Pacific, there are at least three separate populations, which are considered distinct stocks although there is some mixing between them. The California/Oregon/Washington stock winters in coastal Central America and Mexico and migrates to areas ranging from the coast of California to southern British Columbia in summer and fall (NMFS b).

6.2.4.2 Critical habitat
No critical habitat rules has been designated for the Humpback whale.

6.2.4.3 Life history and ecology
Humpbacks generally feed for 6 months of the year on their feeding grounds in Arctic and Antarctic waters. The animals then fast and live off their fat layer for the winter period while in the tropical breeding grounds. Humpbacks eat primarily small schooling fish such as herring, capelin, pollock, and sand lance. Additionally, they commonly consume euphausiid shrimp (NMFS, 1991).

During migration, humpbacks stay near the surface of the ocean. While feeding and calving, they prefer shallow waters. During calving, humpbacks are usually found in the warmest waters available at that latitude. Calving grounds are commonly near offshore reef systems, islands, or continental shores. Humpback feeding grounds are in cold, productive coastal waters (NMFS b).

6.2.4.4 Population trends and risks
Humpbacks are increasing in abundance in much of their range. In the North Pacific, humpback abundance was estimated at fewer than 1,400 whales in 1966, after heavy commercial exploitation. The current abundance estimate for the North Pacific is about 20,000 whales. Population for the California/Oregon/Washington stock is estimated to be at least 1,250. The central North Pacific and California/Oregon/Washington stocks seem to be increasing.

Humpback whales face a series of threats including entanglement in fishing gear (bycatch), ship strikes, whale watch harassment, habitat impacts, and proposed harvest (NMFS b).

6.2.5 Killer whale, Southern Resident DPS
The killer whale (*Orcinus orca*) Southern Resident Distinct Population Segment (DPS) was listed as endangered on November 18, 2005 (70 FR 69903). A DPS is treated as a unique species under the ESA.

6.2.5.1 Species range
The Southern Resident killer whale population range during the spring, summer, and fall includes the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Their occurrence has been documented in the coastal waters off of Oregon, Washington, Vancouver Island, central California, and Queen Charlotte Islands. Relatively little is known about the winter movements and range of the Southern Resident stock (NMFS c).

6.2.5.2 Critical habitat

Three specific areas in the state of Washington were designated as critical habitat for the Southern Resident killer whale on November 29, 2006 (71 FR 69054). These include (1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca, which comprise approximately 2,560 square miles (6,630 sq km) of marine habitat. These areas are shown in Figure 6.3. Critical habitat does not include areas less than 20 feet deep relative to extreme high water. Eighteen military sites were excluded due to national security concerns.

The primary constituent elements essential for conservation of the Southern Resident killer whale are: (1) Water quality to support growth and development; (2) Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and (3) Passage conditions to allow for migration, resting, and foraging.

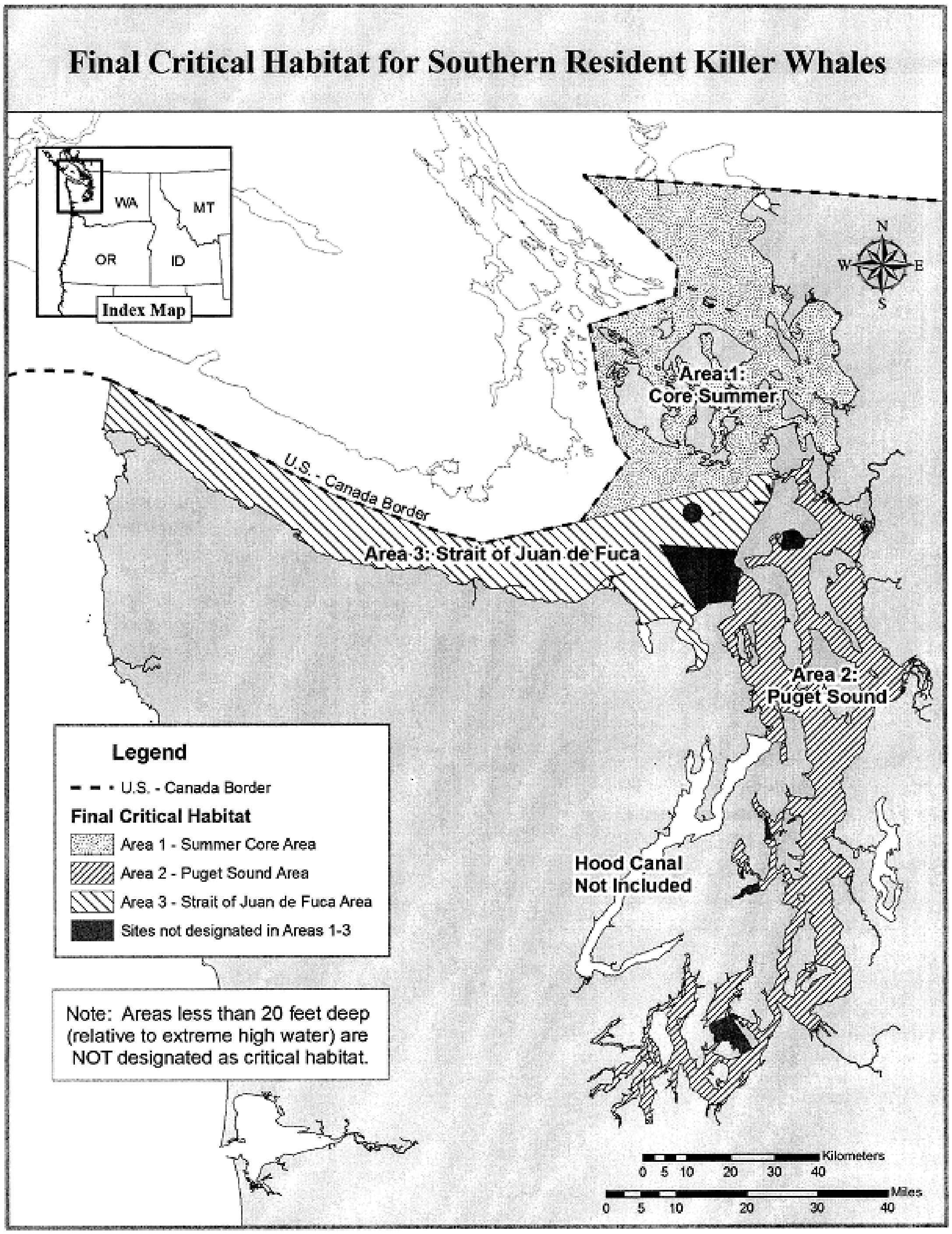

Figure 6.3 Critical Habitat for Southern Resident Killer Whales (Source: 71 FR 69069)

6.2.5.3 Life history and ecology

In the eastern North Pacific, the Resident killer whale populations mainly feed on salmonids, such as Chinook salmon and chum salmon. Like all cetaceans, killer whales depend heavily on underwater sound for orientation, feeding, and communication.

Resident type killer whales occur in large social groups termed "pods," which are defined to be groups of whales that are seen in association with one another greater than 50% of the time.

The pods represent collections of matrilines (a matriarch and all her descendents), which have been found to be the stable social unit. Three pods make up the Southern resident DPS. Southern Residents have not been observed associating with other resident whales, and genetic data suggest that Southern Residents rarely, if ever, interbreed with other killer whale populations.

Sexual maturity of female killer whales is achieved when the whales reach lengths of approximately 15-18 feet (4.6 - 5.4 m), depending on geographic region. The gestation period for killer whales varies from 15-18 months, and birth may take place in any month. Calves are nursed for at least 1 year, and may be weaned between 1 and 2 years of age. The birth rate for killer whales is not well understood, but, in some populations, is estimated as every 5 years for an average period of 25 years (NMFS c).

6.2.5.4 Population trends and risks

The Southern Resident killer whale population is currently estimated at about 88 whales, a decline from its estimated historical level of about 200 during the mid- to late 1800s. Beginning in about 1967, the live-capture fishery for oceanarium display removed an estimated 47 whales and caused an immediate decline in Southern Resident numbers. The population fell an estimated 30% to about 67 whales by 1971. By 2003, the population had increased to 83 whales.

Current threats related to human activities include contaminants such as polycholorobiphenyls (PCBs), depletion of prey due to overfishing and habitat degradation, ship collisions, and oil spills. Additional threats may include disturbance from such activities as noise from industrial and military activities, entanglement in fishing gear, and whale-watching. Outside U.S. waters, directed catch of killer whales still occurs, though these levels are presumed low (NMFS c).

6.2.6 North Pacific right whale

The North Pacific right whale (*Eubalaena japonica*) has been listed as endangered under the ESA since 1973. It was originally listed as the “northern right whale” under the Endangered Species Conservation Act on June 2, 1970 (35 FR 8491).

6.2.6.1 Species range

North Pacific right whales inhabit the Pacific Ocean, particularly between 20° and 60° latitude. Sightings have been reported as far south as central Baja California in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and Sea of Okhotsk in the summer (NMFS d).

A range map for this species is shown in Figure 6.4. Right whales have occurred historically in all the world's oceans from temperate to subpolar latitudes. They primarily occur in coastal or shelf waters, although movements over deep waters are known. For much of the year, their distribution is strongly correlated to the distribution of their prey. During winter, right whales occur in lower latitudes and coastal waters where calving takes place. However, the whereabouts of much of the population during winter remains unknown. Right whales migrate to higher latitudes during spring and summer (NMFS d).

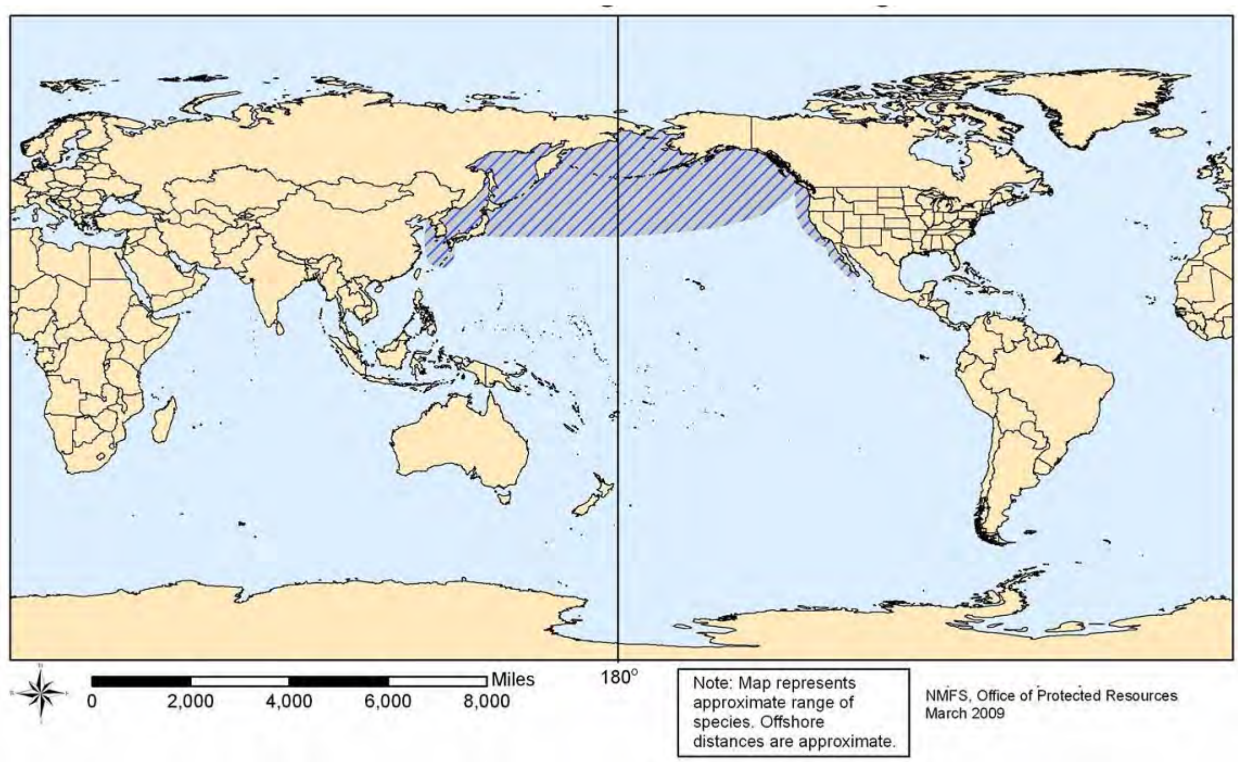

Figure 6.4 North Pacific Right Whale Range (Source: http://nmfs.noaa.gov)

6.2.6.2 Critical habitat

Two critical habitat areas, one in the Bering Sea and the other in the Gulf of Alaska, were designated for the northern right whale on July 6, 2006 (71 FR 38277). After the North Pacific right whale was listed as a separate endangered species, these same areas were designated as its critical habitat on April 8, 2008 (73 FR 19000). No critical habitat for this species lies within the action area.

The primary constituent elements of the North Pacific right whale are the copepods *Calanus marshallae*, *Neocalanus cristatus*, and *N. plumchris*, and the euphausiid *Thysanoessa raschii*, in areas of the North Pacific Ocean in which North Pacific right whales are known or believed to feed (NMFS d).

6.2.6.3 Life history and ecology

Females give birth to their first calf at an average age of 9-10 years. Gestation lasts approximately 1 year. Calves are usually weaned toward the end of their first year. Most known right whale nursery areas are in shallow, coastal waters. The International Whaling Commission has identified four categories of right whale habitats:

1. Feeding - areas with copepod and krill densities that routinely elicit feeding behavior and are visited seasonally
2. Calving - areas routinely used for calving and neonatal nursing
3. Nursery - aggregation area(s) where nursing females feed and suckle
4. Breeding - locations where mating behavior leading to conception occurs; breeding areas are not known for any population

Migratory patterns of the North Pacific right whale are unknown, although it is thought the whales spend the summer on high-latitude feeding grounds and migrate to more temperate waters during the winter.

Right whales feed from spring to fall, and also in winter in certain areas. The primary food sources are zooplankton, including copepods, euphausiids, and cyprids. Unlike other baleen whales, right whales are skimmers: they feed by removing prey from the water using baleen while moving with their mouth open through a patch of zooplankton.

It is believed that right whales live at least 50 years, but there are few actual longevity data (NMFS d).

6.2.6.4 Population trends and risks

There are no reliable estimates of current abundance or trends for right whales in the North Pacific. The pre-exploitation size of this stock exceeded 11,000 animals. The eastern North Pacific population is known to be significantly fewer than 900. Over the past forty years, most sightings in the eastern North Pacific have been of single whales. However, during the last few years, small groups of right whales have been sighted. There was only one confirmed sighting of calves in the 20th century. Further, the North Pacific animals are known to have been subjected to large illegal Soviet catches in the early 1960s.

Because of their rare occurrence and scattered distribution, it is impossible to assess the possible threats of ship strikes and entanglement. Thus, the estimated annual rate of human-caused mortality and serious injury appears minimal. The reasons for the apparent lack of recovery for right whales in this region are unknown (NMFS d).

6.2.7 Sei whale

The sei whale (*Balaenoptera borealis*) was included in the first list of endangered species under the Endangered Species Conservation Act on June 2, 1970 (35 FR 8491).

6.2.7.1 Species range

Sei whales occur in subtropical, temperate, and subpolar waters around the world. They prefer temperate waters in the mid-latitudes on the continental shelf edge and slope worldwide, and are usually observed in deeper waters of oceanic areas far from the coastline. The entire distribution and movement pattern of this species is not well known. Sei whales may unpredictably and randomly occur in a specific area, sometimes in large numbers. These events may occur suddenly and then not occur again for long periods of time. Populations of sei whales, like other rorquals, may seasonally migrate toward the lower latitudes during the winter and higher latitudes during the summer (NMFS e).

6.2.7.2 Critical habitat

Critical habitat has not been designated for the sei whale.

6.2.7.3 Life history and ecology

Sei whales are usually observed singly or in small groups of 2-5 animals, but are occasionally found in larger (30-50) loose aggregations. They are capable of diving 5-20 minutes to opportunistically feed on plankton (e.g., copepods and krill), small schooling fish, and cephalopods (e.g., squid) by both gulping and skimming. They prefer to feed at dawn and may exhibit unpredictable behavior while foraging and feeding on prey.

Sei whales become sexually mature at 6-12 years of age when they reach about 45 ft (13 m) in length, and generally mate and give birth during the winter in lower latitudes. Females breed every 2-3 years, with a gestation period of 11-13 months. Females give birth to a single calf that is about 15 ft (4.6 m) long and weighs about 1,500 lbs (680 kg). Calves are usually nursed for 6-9 months before being weaned on the preferred feeding grounds. Sei whales have an estimated lifespan of 50-70 years (NMFS e).

6.2.7.4 Population trends and risks

For management purposes, sei whales inhabiting U.S. waters have been divided into four stocks: the Hawaiian Stock, Eastern North Pacific Stock, Nova Scotia Stock, and Western North Atlantic Stock. The estimated population in the Eastern North Pacific stock is 35-55. Scientists estimate that the current worldwide population is about 80,000 individuals. After commercial whaling exhausted all known populations of this species, sei whales in the North Atlantic and North Pacific combine are considered to be relatively abundant, but the population in the Southern Ocean remains greatly depleted.

During the 19th and 20th centuries, sei whales were targeted and greatly depleted by commercial hunting and whaling, with an estimated 300,000 animals killed for their meat and oil. Other threats that may affect sei whale populations are ship strikes and interactions with fishing gear such as traps and pots (NMFS e).

6.2.8 Sperm whale

The sperm whale (*Physeter macrocephalus*) was listed as endangered throughout its range on June 2, 1970 in the first list of endangered species under the Endangered Species Conservation Act of 1969 (35 FR 8491).

6.2.8.1 Species range

Sperm whales inhabit all oceans of the world. They can be seen close to the edge of pack ice in both hemispheres and are also common along the equator, especially in the Pacific. Sperm whales are found throughout the world's oceans in deep waters between about 60° N and 60° S latitudes. Their distribution is dependent on their food source and suitable conditions for breeding, and varies with the sex and age composition of the group. Sperm whale migrations are not as predictable or well understood as migrations of most baleen whales. In some mid-latitudes, there seems to be a general trend to migrate north and south depending on the seasons (whales move poleward in the summer). However, in tropical and temperate areas, there appears to be no obvious seasonal migration.

For management purposes, sperm whales inhabiting U.S. waters have been divided into five stocks. The California-Oregon-Washington stock are found year-round in California waters, but they reach peak abundance from April through mid-June and from the end of August through mid-November. They are seen in every season except winter (Dec-Feb) in Washington and Oregon.

Sperm whales tend to inhabit areas with a water depth of 1968 feet (600 m) or more, and are uncommon in waters less than 984 feet (300 m) deep. Female sperm whales are generally found in deep waters (at least 3280 feet, or 1000 m) of low latitudes (less than 40°, except in the North Pacific where they are found up to 50°). These conditions generally correspond to sea surface temperatures greater than 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land.

Immature males will stay with female sperm whales in tropical and subtropical waters until they begin to slowly migrate towards the poles, anywhere between ages 4 and 21 years old. Older, larger males are generally found near the edge of pack ice in both hemispheres. On occasion, however, these males will return to the warm water breeding area (NMFS f).

6.2.8.2 Critical habitat
Critical habitat has not been designated for the sperm whale.

6.2.8.3 Life history and ecology
Because sperm whales spend most of their time in deep waters, their diet consists of many larger organisms that also occupy deep waters of the ocean. Their principle prey are large squid weighing between 3.5 ounces and 22 pounds (0.1 kg and 10 kg), but they will also eat large demersal and mesopelagic sharks, skates, and fishes. The average dive lasts about 35 minutes and is around 1,312 feet (400 m), however dives may last over an hour and reach depths over 3,280 feet (1,000 m).

Female sperm whales reach sexual maturity around 9 years of age when they are roughly 29 feet (9 m) long. At this point, growth slows and they produce a calf approximately once every five years. After a 14-16 month gestation period, a single calf about 13 feet (4 m) long is born. Although calves will eat solid food before one year of age, they continue to suckle for several years. Females are physically mature around 30 years and 35 feet (10.6 m) long, at which time they stop growing. For about the first 10 years of life, males are only slightly larger than females, but males continue to exhibit substantial growth until they are well into their 30s. Males reach physical maturity around 50 years and when they are 52 feet (16 m) long. Unlike females, puberty in males is prolonged, and may last between ages 10 to 20 years old. Even though males are sexually mature at this time, they often do not actively participate in breeding until their late twenties.

Most females will form lasting bonds with other females of their family, and on average 12 females and their young will form a family unit. While females generally stay with the same unit all their lives in and around tropical waters, young males will leave when they are between 4 and 21 years old and can be found in "bachelor schools", comprising of other males that are about the same age and size. As males get older and larger, they begin to migrate to higher latitudes (toward the poles) and slowly bachelor schools become smaller, until the largest males end up alone. Large sexually mature males that are in their late 20s or older will occasionally return to the tropical breeding areas to mate (NMFS f).

6.2.8.4 Population trends and risks
During the past 2 centuries, commercial whalers took about 1,000,000 sperm whales. Despite this high level of "take", the sperm whale remains the most abundant of the large whale species. Currently, there is no good estimate for the total number of sperm whales worldwide. The best estimate, that there are between 200,000 and 1,500,000 sperm whales, is based on extrapolations from only a few areas that have useful estimates. The most recent abundance estimate for the California-Oregon-Washington stock for the period between 1996 and 2001 is 1,233 sperm whales. Sperm whale abundance appears to have been rather variable off California between 1979/1980 and 1996, but does not show any obvious trends.

Current human threats to sperm whales include ship strikes, entanglements in fishing gear (although these are not as great of a threat to sperm whales as they are to more coastal cetaceans), disturbance by anthropogenic noise (notably in areas of oil and gas activities or where shipping activity is high), accumulation of stable pollutants (e.g. PCBs, chlorinated pesticides (DDT, DDE, etc.), polycyclic aromatic hydrocarbons (PAHs), and heavy metals). The potential impact of coastal pollution may be an issue for this species in portions of its habitat. Historically, whaling was a threat to this species, but has virtually ceased with the implementation of a moratorium against whaling by the IWC in 1988.

Natural threats to sperm whales include killer whales, which have been documented killing at least one sperm whale in California. Typically, however, it is believed that most killer whale attacks are unsuccessful. Pilot whales have been observed harassing sperm whales, but it is unclear if they pose any real threat. Large sharks may also be a threat, especially for young sperm whales (NMFS f).

6.3 THREATENED AND ENDANGERED FISH

The threatened and endangered fish discussed below fall into two categories: marine and anadromous. Marine fish spend their entire life in salt water. Anadromous fish are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn. The three marine fish discussed are all rockfish. The following three paragraphs include life history and designated critical habitat which is common to all three rockfish species.

Rockfish

The three marine fish discussed (bocaccio, canary rockfish and yelloweye rockfish) are all rockfish, which are unusual among the bony fishes in that fertilization and embryo development is internal, and females give birth to live larval young. Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans. Juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of rockfish, associated with kelp beds, rocky reefs, pinnacles, and sharp drop-offs (NMFS k,l,m).

Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents. Juveniles and subadults tend to be more common than adults in shallow water and are associated with rocky reefs, kelp canopies, and artificial structures, such as piers and oil platforms. Adults generally move into deeper water as they increase in size and age but usually exhibit strong site fidelity to rocky bottoms and outcrops where they hover in loose groups just above the bottom (NMFS k,l,m).

Critical Habitat was designated for all three rockfish on November 13, 2014 (79 FR 68041). All critical habitat is found scattered throughout the Puget Sound (See Figure 6.5) (NMFS x). The specific areas in the final designation include 590.4 square miles of nearshore habitat for canary rockfish and bocaccio, and 414.1 square miles of deepwater habitat for yelloweye rockfish, canary rockfish and bocaccio.

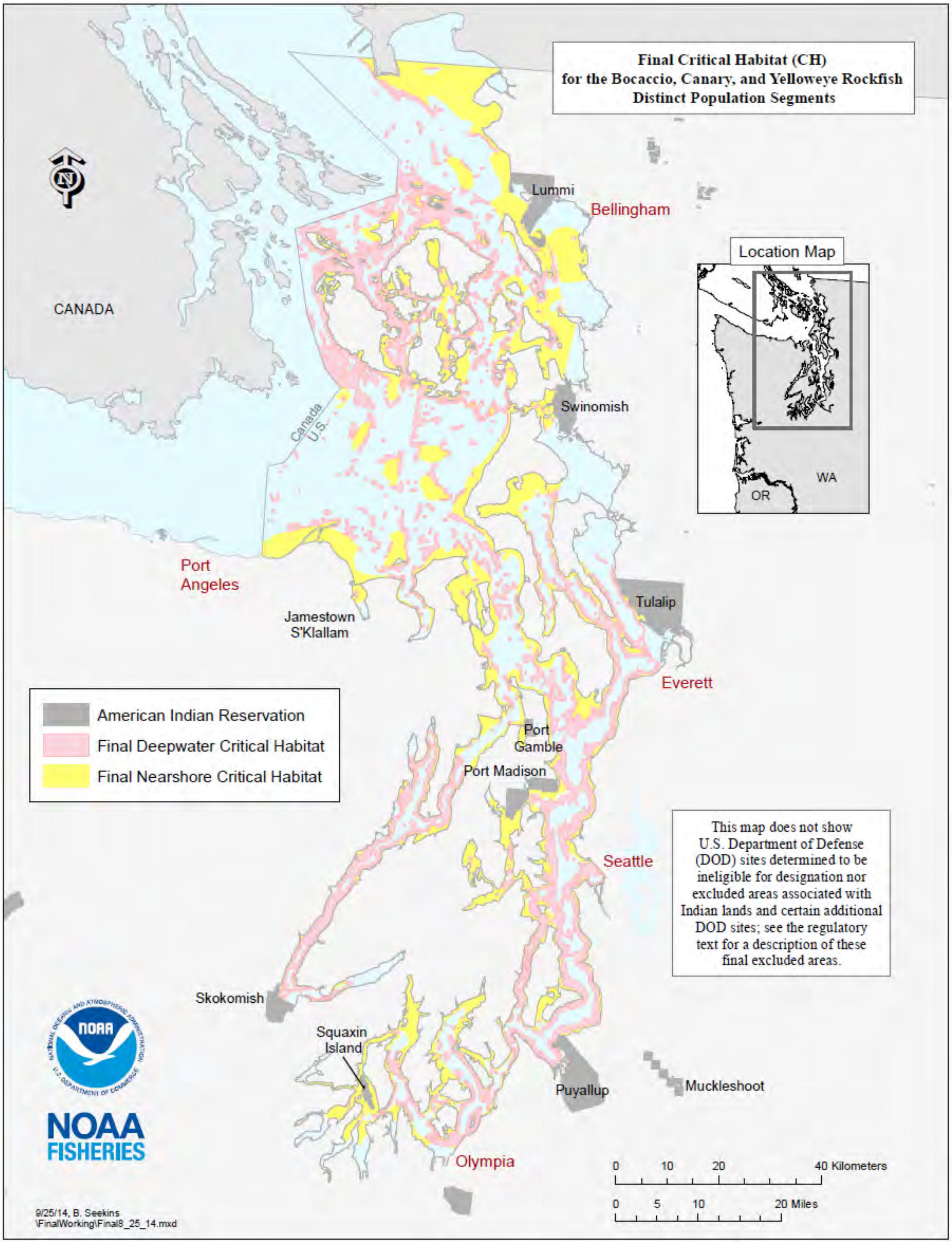

Figure 6.5 Rockfish Critical Habitat (Source http://www.westcoast.fisheries.noaa.gov/)

6.3.1 Bocaccio

The bocaccio (*Sebastes paucispinis*) is a large Pacific coast rockfish. The Puget Sound/Georgia Basin DPS of the species was listed as endangered on April 13, 2011 (76 FR 20558).

6.3.1.1 Species range

Bocaccio range from Punta Blanca, Baja California, to the Gulf of Alaska off Krozoff and Kodiak Islands. They are most common between Oregon and northern Baja California. In Puget Sound, most bocaccio are found south of Tacoma Narrows. Bocaccio are most common between 160 and 820 feet (50-250 m) depth, but may be found as deep as 1,560 feet (475m) (NMFS k).

6.3.1.2 Critical habitat

Critical Habitat was designated for Bocaccio on November 13, 2014 (79 FR 68041). All critical habitat is found scattered throughout the Puget Sound. The specific areas in the final designation include 590.4 square miles of nearshore habitat and 414.1 square miles of deepwater habitat. A critical habitat map for the species is shown in Figure 6.5 (NMFS x).

6.3.1.3 Life history and ecology

Approximately 50 percent of adult bocaccio mature in 4 to 6 years. Bocaccio are difficult to age but are suspected to live as long as 50 years. Fecundity in female bocaccio ranges from 20,000 to over 2 million eggs, considerably more than many other rockfish species (NMFS k).

6.3.1.4 Population trends and risks

Recreational catch and effort data spanning 12 years from the mid-1970s to mid-1990s suggest declines in the population over time. Currently there are no survey data being taken for this species, but few of these fish are caught by fishermen and none have been caught by Washington state biological surveys in 20 years, suggesting very low population abundance. They are thought to be at an abundance that is less than 10% of their unfished abundance. A 2005 stock assessment by NOAA Fisheries suggests bocaccio have higher populations than was thought to be the case (NMFS k).

Bocaccio are fished directly and are often caught as bycatch by other fisheries, including those for salmon. Adverse environmental factors led to recruitment failures in the early- to mid-1990s (NMFS k).

6.3.2 Canary rockfish

The canary rockfish (*Sebastes pinniger*) was listed as threatened on April 13, 2011 (76 FR 20558).

6.3.2.1 Species range

Canary rockfish range between Baja California, and the Western Gulf of Alaska. Within this range, canary rockfish are most common off the coast of central Oregon. They primarily inhabit waters 160 to 820 feet (50 to 250 m) deep but may be found to 1400 feet (425 m) (NMFS l).

6.3.2.2 Critical habitat

Critical Habitat was designated for canary rockfish on November 13, 2014 (79 FR 68041). All critical habitat is found scattered throughout the Puget Sound. The specific areas in the final designation include 590.4 square miles of nearshore habitat and 414.1 square miles of deepwater habitat. A critical habitat map for the species is shown in Figure 6.5 (NMFS x).

6.3.2.3 Life history and ecology

Approximately 50 percent of adult canary rockfish are mature at 14 inches (36 cm) total length (about 5 to 6 years of age). Canary rockfish can live to be 75 years old. Fecundity in female canary rockfish ranges from 260,000 to 1.9 million eggs, considerably more than many other rockfish species (NMFS l).

6.3.2.4 Population trends and risks

Recreational catch and effort data spanning 12 years from the mid-1970s to mid-1990s suggest declines in the population over time. Currently there are no survey data being taken for this species, but few of these fish are currently caught by fishermen, suggesting low population abundance. Canary rockfish were one of the three principal species caught in Puget Sound in the 1960s.

Canary rockfish are fished directly and are often caught as bycatch in other fisheries, including those for salmon. Adverse environmental factors led to recruitment failures in the early- to mid-1990s (NMFS l).

6.3.3 Yelloweye rockfish

The yelloweye rockfish (*Sebastes ruberrimus*) was listed as threatened on April 13, 2011 (76 FR 20558).

6.3.3.1 Species range

Yelloweye rockfish range from northern Baja California to the Aleutian Islands, Alaska, but are most common from central California northward to the Gulf of Alaska. They occur in waters 80 to 1560 feet (25 to 475 m) deep, but are most commonly found between 300 to 590 feet (91 to 180 m) (NMFS m).

6.3.3.2 Critical habitat

Critical Habitat was designated for yelloweye rockfish on November 13, 2014 (79 FR 68041). All critical habitat is found scattered throughout the Puget Sound. The specific areas in the final designation include 414.1 square miles of deepwater habitat. A critical habitat map for the species is shown in Figure 6.5 (NMFS x).

6.3.3.3 Life history and ecology

Approximately 50 percent of adult yelloweye rockfish are mature by 16 inches (41 cm) total length (about 6 years of age). Yelloweye rockfish are among the longest lived of rockfishes, living up to 118 years old. Fecundity in female yelloweye rockfish ranges from 1.2 to 2.7 million eggs, considerably more than many other rockfish species (NMFS m).

6.3.3.4 Population trends and risks

Recreational catch and effort data spanning 12 years from the mid-1970s to mid-1990s suggest declines in the population over time. Currently there are no survey data being taken for this species, but few of these fish are caught by fishermen, suggesting low population abundance.

Yelloweye rockfish are fished directly and are often caught as bycatch in other fisheries, including those for salmon. Adverse environmental factors led to recruitment failures in the early- to mid-1990s (NMFS m).

<u>Anadromous Fish</u>

The remainder of the fish species discussed in this section are anadromous, meaning they are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn. Most of the species discussed are salmonids (of the genus *Oncorhynchus*), which includes all of the salmon and steelhead species. The other two species discussed are the Pacific eulachon and the North American green sturgeon.

6.3.4 Pacific eulachon

Eulachon (*Thaleichthys pacificus*), commonly called smelt, candlefish, or hooligan, are a small, anadromous fish from the eastern Pacific Ocean. The Southern DPS of the species was listed as threatened on April 13, 2011 (76 FR 20558).

6.3.4.1 Species range

Eulachon are endemic to the eastern Pacific Ocean, ranging from northern California to southwest Alaska and into the southeastern Bering Sea. In the continental United States, most eulachon originate in the Columbia River Basin. Other areas in the United States where eulachon have been documented include the Sacramento River, Russian River, Humboldt Bay and several nearby smaller coastal rivers, and the Klamath River in California; the Rogue River and Umpqua Rivers in Oregon; and infrequently in coastal rivers and tributaries to Puget Sound, Washington. A range map for this species is shown in Figure 6.6. Eulachon occur in nearshore ocean waters and to 1000 feet (300 m) in depth, except for the brief spawning runs into their natal (birth) streams (NMFS n).

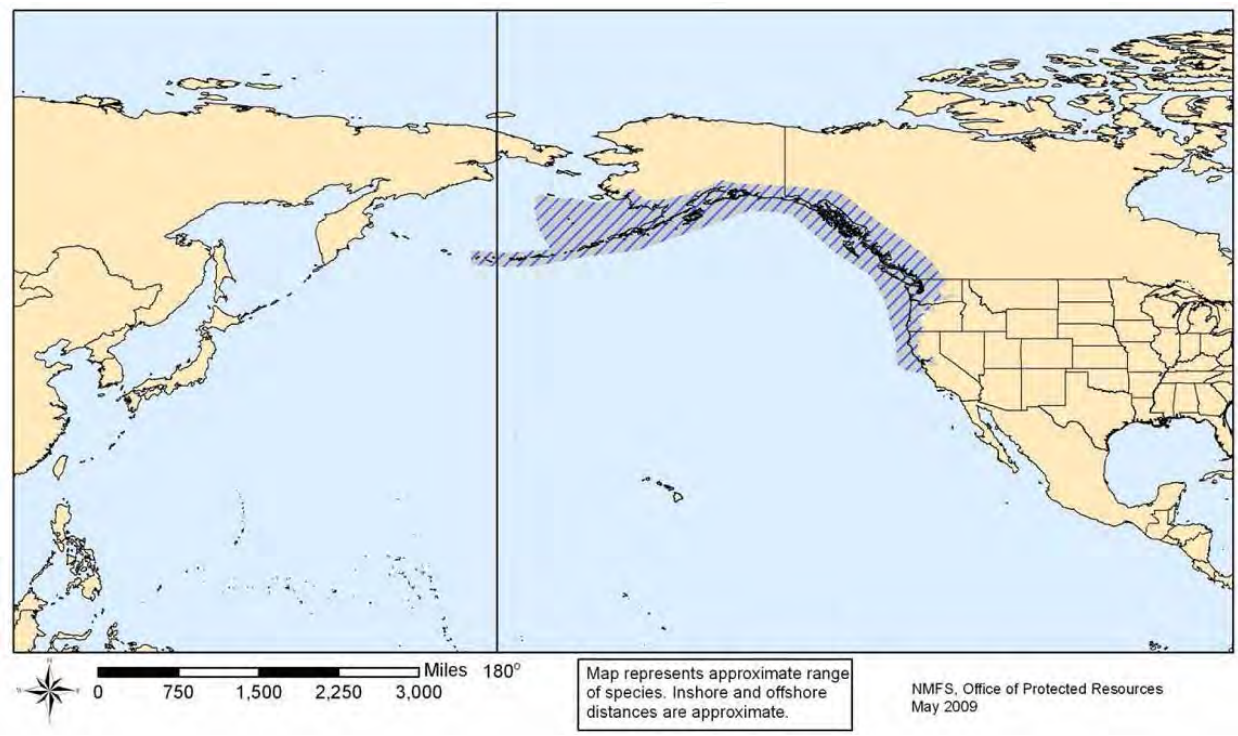

Figure 6.6 Pacific Eulachon Range Map (Source: http://www.nmfs.noaa.gov)

6.3.4.2 Critical habitat

Sixteen specific areas within the states of California, Oregon, and Washington, of which thirteen are in Washington and Oregon, were designated as critical habitat for the southern Distinct Population Segment (DPS) of Pacific eulachon on October 20, 2011 (76 FR 65324). The designated areas are a combination of freshwater creeks and rivers and their associated estuaries, comprising approximately 539 km (335 mi) of habitat.

Critical habitat for this DPS includes portions of the Umpqua River, Tenmile Creek, and Sandy River in Oregon; Grays River, Skamokawa Creek, Elochoman River, Cowlitz River, Toutle River, Kalama River, Lewis River, Quinault River, and Elwha River in Washington; and Columbia River in both states. Tribal lands of four Indian tribes are excluded from designation. Critical habitat areas in Washington and northern Oregon are shown in Figure 6.7 and areas in southern Oregon and northern California are shown in Figure 6.8. There is no critical habitat in the federal waters which comprise the Draft Permit action area.

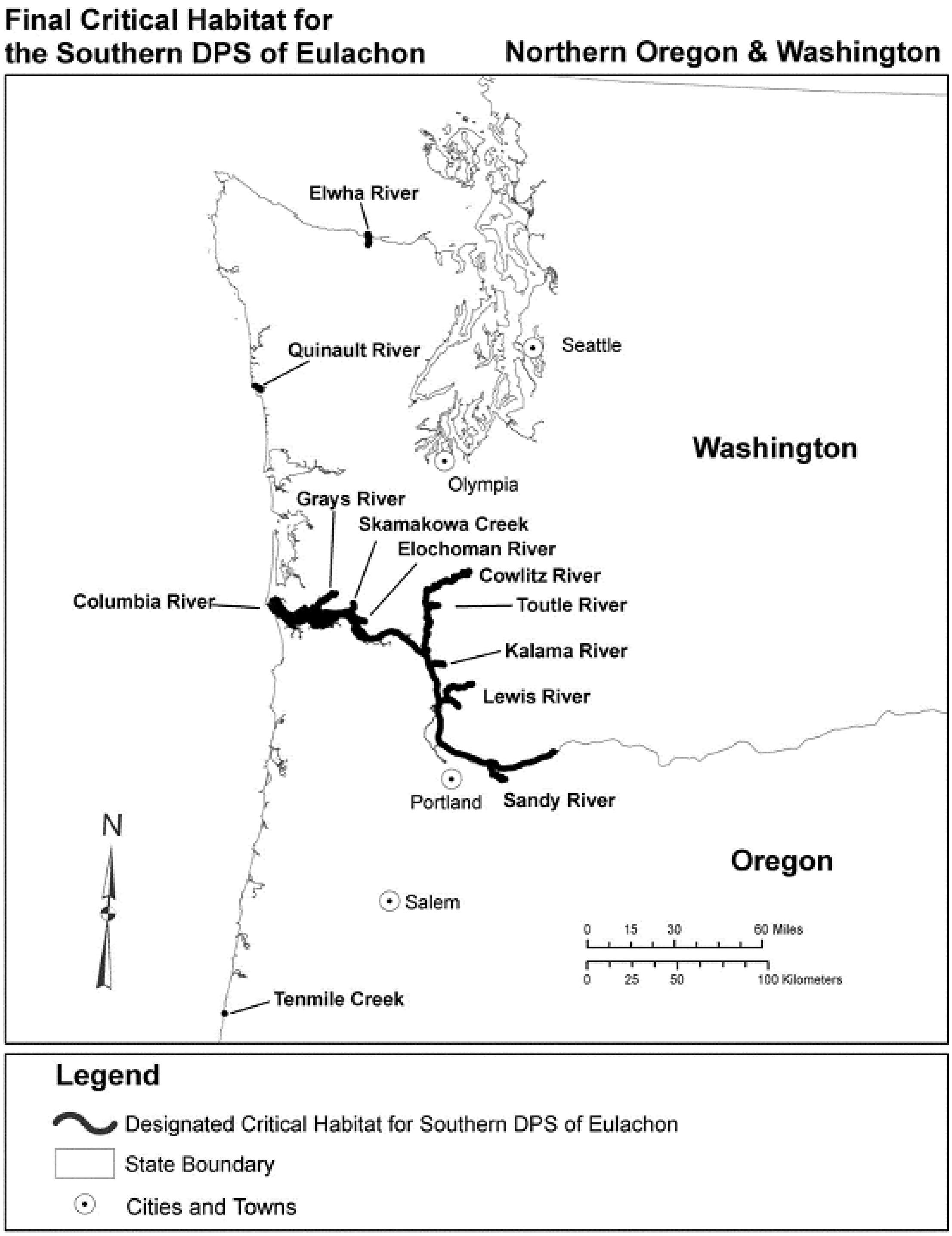

Figure 6.7 Critical Habitat for the Pacific Eulachon Southern DPS in Washington and Northern Oregon (Source: 76 FR 65352)

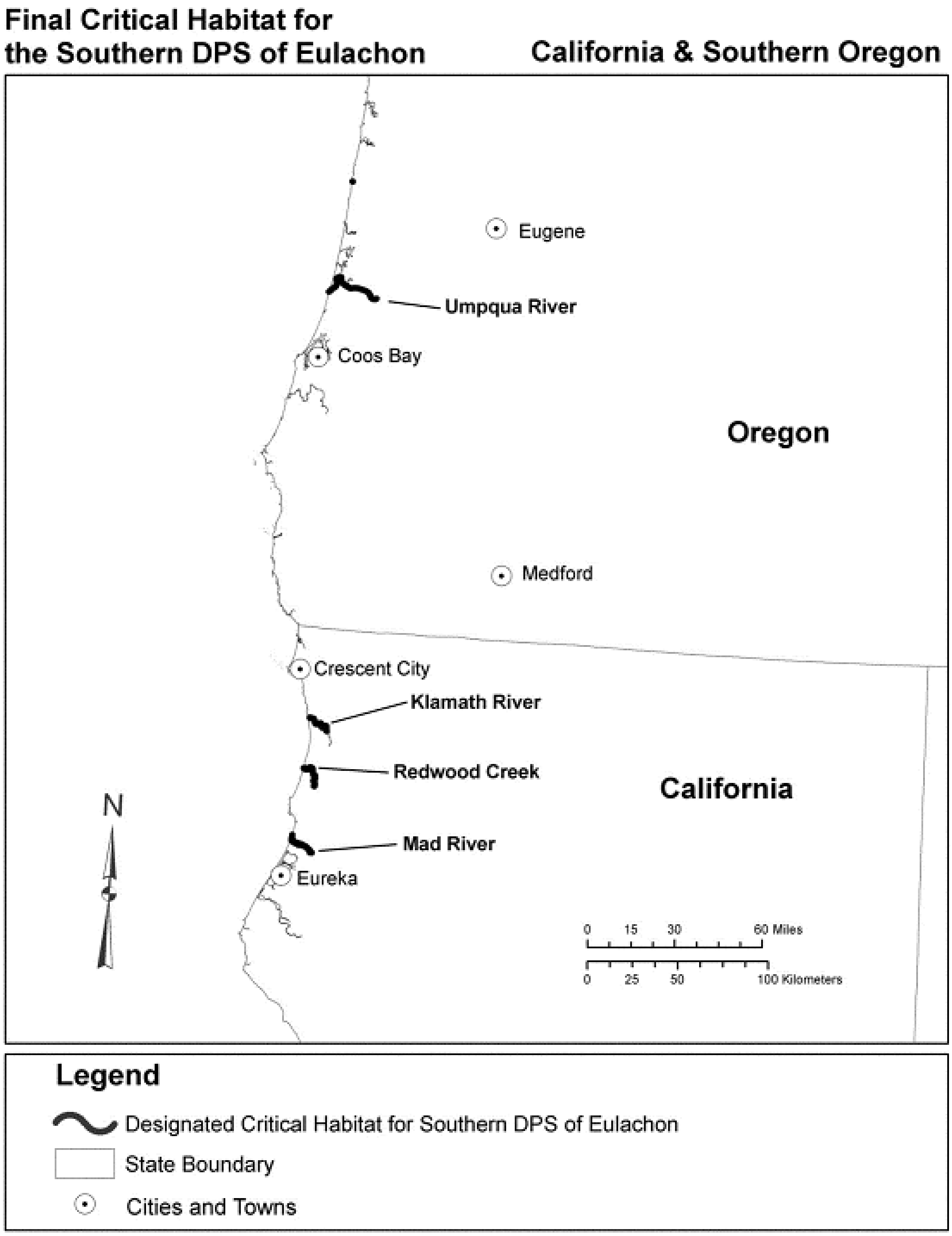

Figure 6.8 Critical Habitat for the Pacific Eulachon Southern DPS in Southern Oregon and Northern California (Source: 76 FR 65351)

6.3.4.3 Life history and ecology

Eulachon typically spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid-spring. Spawning grounds are typically in the lower reaches of larger snowmelt-fed rivers with water temperatures ranging from 39 to 50° F (4-10° C). Spawning occurs over sand or coarse gravel substrates. Eggs are fertilized in the water column. After fertilization, the eggs sink and adhere to the river bottom. Most eulachon adults die after spawning. Eulachon eggs hatch in 20 to 40 days. The larvae are then carried downstream and are dispersed by estuarine and ocean currents shortly after hatching. Juvenile eulachon move from shallow nearshore areas to mid-depth areas. Within the Columbia River Basin, the major and most consistent spawning runs occur in the mainstem of the Columbia River as far upstream as the Bonneville Dam, and in the Cowlitz River. Eulachon feed on plankton (NMFS n).

6.3.4.4 Population trends and risks

Eulachon abundance exhibits considerable year-to-year variability. However, nearly all spawning runs from California to southeastern Alaska have declined in the past 20 years, especially since the mid-1990s. From 1938 to 1992, the median commercial catch of eulachon in the Columbia River was approximately 2 million pounds (900,000 kg) but from 1993 to 2006, the median catch had declined to approximately 43,000 pounds (19,500 kg), representing a nearly 98 percent reduction in catch from the prior period. Eulachon returns in British Columbia rivers similarly suffered severe declines in the mid-1990s and, despite increased returns during 2001 to 2003, presently remain at very low levels. The populations in the Klamath River, Mad River, Redwood Creek, and Sacramento River are likely extirpated or nearly so.
Habitat loss and degradation threaten eulachon, particularly in the Columbia River basin. Hydroelectric dams block access to historical spawning grounds and affect the quality of spawning substrates through flow management, altered delivery of coarse sediments, and siltation. The release of fine sediments from behind a U.S. Army Corps of Engineers sediment retention structure on the Toutle River has been negatively correlated with Cowlitz River eulachon returns 3 to 4 years later and is thus implicated in harming eulachon in this river system, though the exact cause of the effect is undetermined. Dredging activities in the Cowlitz and Columbia rivers during spawning runs may entrain and kill fish or otherwise result in decreased spawning success.

Eulachon have been shown to carry high levels of chemical pollutants, and although it has not been demonstrated that high contaminant loads in eulachon result in increased mortality or reduced reproductive success, such effects have been shown in other fish species. Eulachon harvest has been curtailed significantly in response to population declines. However, existing regulatory mechanisms may be inadequate to recover eulachon stocks.

Global climate change may threaten eulachon, particularly in the southern portion of its range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success (NMFS n).

<u>Salmonids</u>

Twenty-eight ESA listed salmonid populations representing five species are believed to occur in the Draft Permit action area. These five species, listed with their ESA status in Table 6.2, are divided into Evolutionarily Significant Units (ESUs), which are distinct population groups that are reproductively isolated and contribute to the ecological or genetic diversity of the species (Waples, 1991). An ESU is considered to be a “species” under the ESA. A salmonid ESU generally includes all naturally spawned populations in the named waterway (including tributaries) and time period, as well as related hatchery-bred fish.

Table 6.2 ESA-Listed Salmonids Occurring within the Draft Permit Action Area

Species	ESU	Status
Chinook salmon (*Oncorhynchus tshawytscha*) – 9 ESUs	CA coastal	T
	Central Valley spring-run	T
	Lower Columbia River	T
	Puget Sound	T
	Sacramento River winter-run	E
	Snake River fall-run	T
	Snake River spring/summer-run	T
	Upper Columbia spring-run	E
	Upper Willamette River	T
Coho salmon (*Oncorhynchus kisutch*) – 4 ESUs	Central California Coast	E
	Lower Columbia River	T
	Oregon Coast	T
	Southern Oregon/Northern California Coasts	T
Chum salmon (*Oncorhynchus keta*) – 2 ESUs	Columbia River	T
	Hood Canal summer-run	T
Sockeye salmon (*Oncorhynchus nerka*) – 2 ESUs	Ozette Lake, WA	T
	Snake River	E
Steelhead (*Oncorhynchus mykiss*) – 11 ESUs	Central CA coast	T
	Central Valley CA	T
	Lower Columbia River	T
	Middle Columbia River	T
	Northern California	T
	Puget Sound	T
	Snake River Basin	T
	South central CA coast	T
	Southern CA coast	E
	Upper Columbia River Basin	T
	Upper Willamette River	T

Salmonid species on the west coast of the United States have experienced dramatic declines in abundance during the past several decades as a result of various human-induced and natural factors. There is no single factor solely responsible for this decline, given the complexity of the salmon species life history and the ecosystems in which they reside. Broad categories of factors which have significantly affected the status of these species include water storage, withdrawal, conveyance, and diversion systems; natural resource use and extraction; loss of the spatial and temporal connectivity between and the complexity of watersheds; commercial and recreational fishing; introduction of non-native species; habitat modifications; and natural environmental conditions (NMFS q).

6.3.5 Chinook salmon

Nine of the seventeen Chinook salmon (*Oncorhynchus tshawytscha*) ESUs are listed under the ESA as endangered or threatened. The nine that are listed as threatened or endangered were listed on June 28, 2005 (70 FR 37160). Six of these have spawning grounds in Washington or Oregon. The Upper Columbia River Spring-run ESU is listed as endangered. The Snake River Spring/Summer-run, Snake River Fall-run, Puget Sound, Lower Columbia River, and Upper Willamette River ESUs are listed as threatened.

6.3.5.1 Species range

In the ocean off the U.S. coast, Chinook salmon are found from the Bering Strait area off Alaska south to Southern California (NMFS t).

6.3.5.2 Critical habitat

There are nine ESUs of chinook salmon that are listed under the ESA, six of which have critical habitat in Oregon and Washington. In general, critical habitat for chinook salmon encompasses presently or historically accessible reaches of all rivers (including estuarine areas and tributaries) within the range of each listed ESU, which includes all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). A composite of all critical habitat areas for Chinook salmon is shown in Figure 6.9.

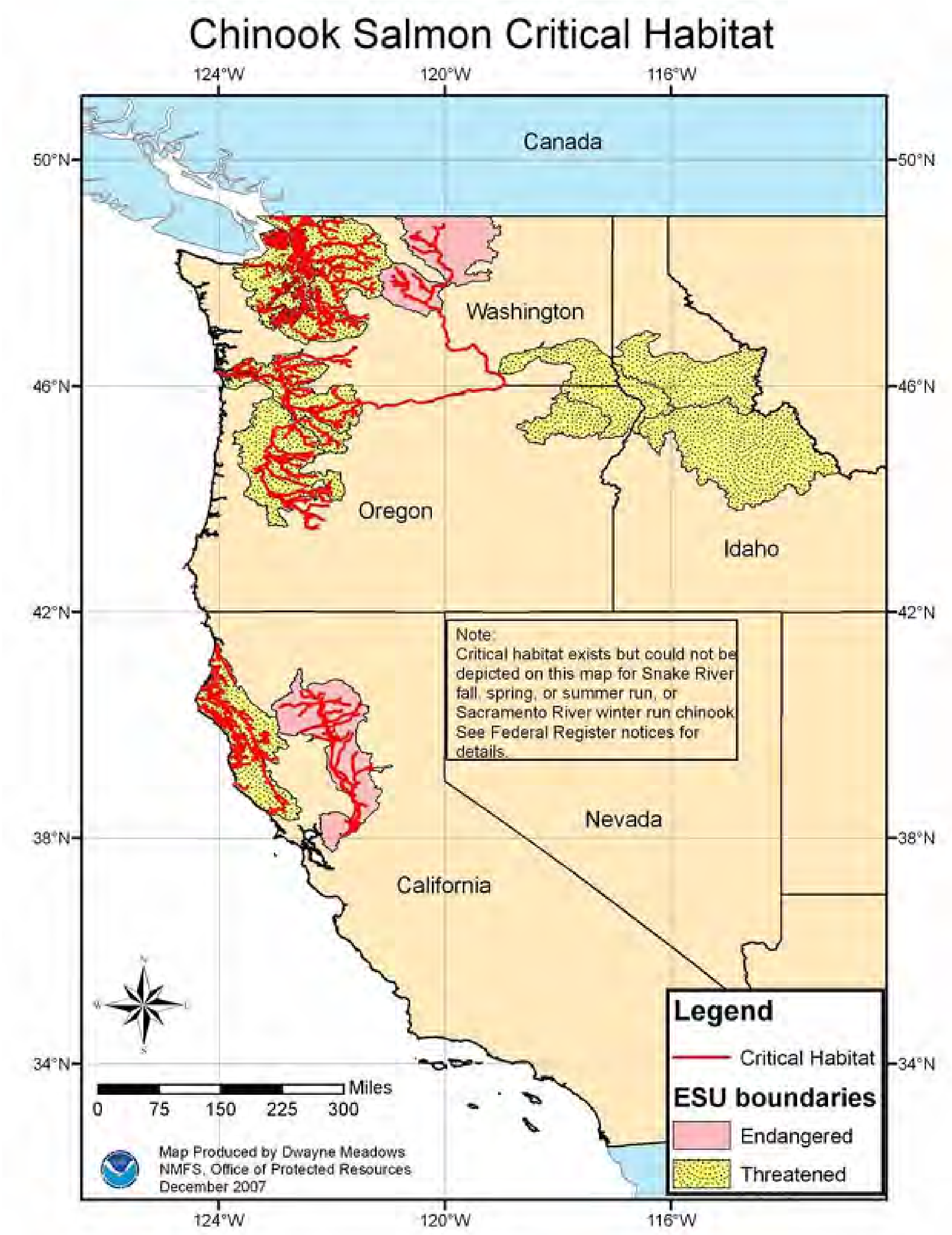

Figure 6.9 Critical Habitat for Chinook Salmon
(Source: http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm)

Critical habitat for four of the Washington/Oregon ESUs (Puget Sound, Lower Columbia River, Upper Willamette River, and Upper Columbia River spring-run) was most recently designated on September 2, 2005 (70 FR 52630). Indian lands are excluded from critical habitat for these ESUs. Specific river basins for each chinook ESU are listed below.

Puget Sound ESU
Critical habitat is designated to include certain areas within the Nooksack, Upper Skagit, Sauk, Lower Skagit, Stillaguamish, Skykomish, Snoqualmie, Snohomish, Lake Washington, Duwamish, Puyallup, Nisqually, Skokomish, Hood Canal, Dungeness/Elwha subbasins. It also includes all nearshore marine areas (including areas adjacent to islands) of the Strait of Georgia (south of the international border), Puget Sound, Hood Canal, and the Strait of Juan de Fuca (to the western end of the Elwha River delta) from the line of extreme high tide out to a depth of 30 meters, except any areas subject to an approved Integrated Natural Resource Management Plan or associated with Department of Defense easements or right-of-ways.

Lower Columbia River ESU
Critical habitat is designated to include certain areas within the Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Lower Columbia, Clackamas, and Lower Willamette subbasins. It also includes the Columbia River from the mouth at the Pacific Ocean upstream to a line connecting the confluences of the Sandy River in Oregon and the Washougal River in Washington.

Upper Willamette River ESU
Critical habitat is designated to include certain areas within the Middle Fork Willamette, Upper Willamette, McKenzie, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, and Clackamas subbasins. It also includes the Columbia River from the mouth at the Pacific Ocean upstream to the confluence of the Clackamas and Willamette rivers, including the Multnomah Channel portion of the lower Willamette River.

Upper Columbia River spring-run ESU
Critical habitat is designated to include certain areas within the Chief Joseph, Methow, Upper Columbia/Entiat, and Wenatchee, subbasins as well as the Columbia River from the mouth at the Pacific Ocean upstream to Rock Island Dam.

Snake River fall run ESU
Critical habitat for the Snake River spring/summer and fall run chinook salmon ESUs was designated on December 28, 1993 (58 FR 68543). The fall run critical habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon Rivers presently or historically accessible to this ESU, except reaches above impassable natural falls and Dworshak and Hells Canyon Dams.

Snake River spring/summer-run ESU
A revision to the Snake River spring/summer-run ESU was published on October 25, 1999. The current critical habitat is designated to include the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches proceeding upstream to the confluence of the Columbia and Snake Rivers; all Snake River reaches from the confluence of the Columbia River upstream to Hells Canyon Dam.

6.3.5.3 Life history and ecology
Chinook feed on terrestrial and aquatic insects, amphipods, and other crustaceans while young, and primarily on other fishes when older.

Juvenile Chinook may spend from 3 months to 2 years in freshwater before migrating to estuarine areas as smolts and then into the ocean to feed and mature. They remain at sea for 1 to 6 years (more commonly 2 to 4 years), with the exception of a small proportion of yearling males (called jack salmon) which mature in freshwater or return after 2 or 3 months in salt water. Adults migrate from a marine environment into the freshwater streams and rivers of their birth in order to mate. They spawn only once and then die.

There are different seasonal (i.e., spring, summer, fall, or winter) "runs" in the migration of Chinook salmon from the ocean to freshwater, even within a single river system. These runs have been identified on the basis of when adult Chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the temperature and flow characteristics of their spawning site, and their actual time of spawning. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes.

Adult female Chinook may deposit eggs in 4 to 5 "nesting pockets" within a single redd (nest). They will guard the redd from just a few days to nearly a month before dying. The eggs will hatch, depending upon water temperatures, 3 to 5 months after deposition. Eggs are deposited at a time to ensure that young salmon fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Two distinct types or races among Chinook salmon have evolved.

One race, described as a "stream-type" Chinook, is found most commonly in headwater streams of large river systems. Stream-type Chinook salmon have a longer freshwater residency, and perform extensive offshore migrations in the central North Pacific before returning to their birth, or natal, streams in the spring or summer months. Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to areas that are more consistently productive and less susceptible to dramatic changes in water flow. At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 3 to 5.25 inches (73-134 mm) depending on the river system, than their ocean-type (subyearling) counterparts, and are therefore able to move offshore relatively quickly.

The second race, called the "ocean-type" Chinook, is commonly found in coastal streams in North America. Ocean-type Chinook typically migrate to sea within the first three months of life, but they may spend up to a year in freshwater prior to emigration to the sea. They also spend their ocean life in coastal waters. Ocean-type Chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. Ocean-type Chinook salmon tend to use estuaries and coastal areas more extensively than other pacific salmonids for juvenile rearing. The evolution of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and unproductive watersheds, or a means of avoiding the impact of seasonal floods. Ocean-type Chinook salmon tend to migrate along the coast. Populations of Chinook salmon south of the Columbia River drainage appear to consist predominantly of ocean-type fish (NMFS t).

6.3.5.4 Population trends and risks

In the U.S. Pacific Northwest states, many wild stocks remain at or near record low levels. Other stocks in this area are already extinct due to a long list of contributing factors, including over-fishing; loss of spawning and rearing habitats; impediments to upstream or downstream migration due to river dams; watershed logging; water allocations for farming, mining and navigation; and generalized industrialization and urbanization throughout the region. Over time, recovery programs for some ESA-listed stock groups in the Sacramento and Columbia rivers are beginning to cause minor improvements (Heard et al., 2007).

6.3.6 Coho salmon

Four of the seven coho salmon (*Oncorhynchus kisutch*) ESUs are listed under the ESA. Three of these have spawning grounds in Oregon and Washington. The Oregon Coast ESU was designated as threatened on June 20, 2011 (76 FR 35755). The Lower Columbia River ESU and Southern Oregon/Northern California ESU were both listed as threatened on June 28, 2005 (70 FR 37160).

6.3.6.1 Species range

The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan. Coho probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations, now considered extinct, are believed to have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington, and the Snake River in Idaho. Coho still occur in Alaska as well (NMFS s).

6.3.6.2 Critical habitat

A composite map of coho salmon critical habitat is shown below in Figure 6.10, followed by descriptions for each ESU.

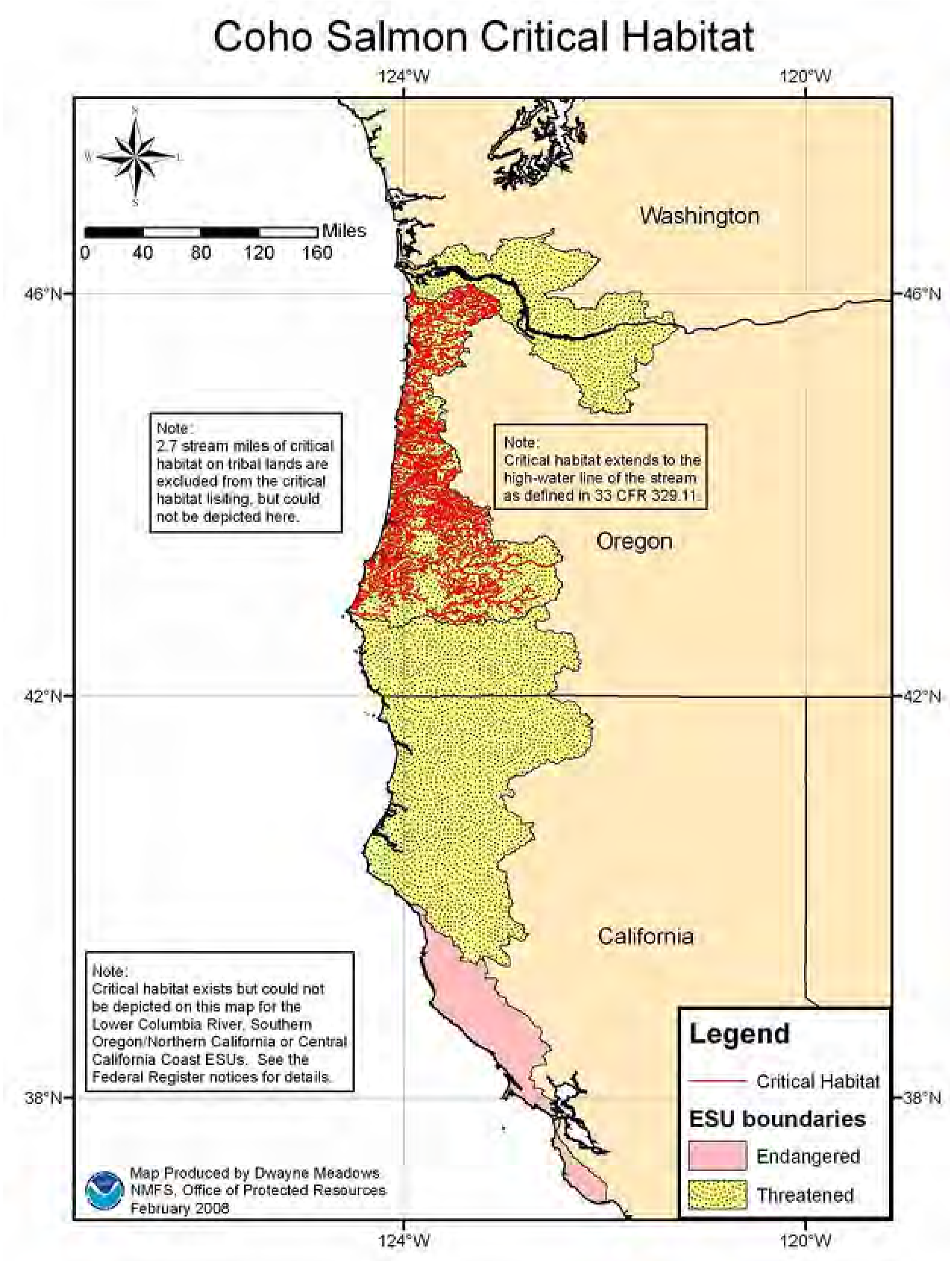

Figure 6.10 Critical Habitat for Coho Salmon
(Source http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm)

Southern Oregon/Northern California Coasts ESU

Critical habitat for this ESU was designated on May 5, 1999 (64 FR 24049) as all river reaches (including estuarine areas and tributaries) accessible to the ESU within its range, including all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years. The current freshwater and estuarine range of the population extends from the Mattole River in California to the Elk River in Oregon, inclusive. Indian tribal lands are excluded from critical habitat.

Oregon Coast ESU
Critical habitat for the Oregon Coast coho ESU was designated on February 11, 2008 (73 FR 7816). It includes parts of the Necanicum, Nehalem, Wilson/Trask/Nestucca, Siletz/Yaquina, Alsea, Siuslaw, Siltcoos, North Fork Umpqua, South Fork Umpqua, Umpqua, Coos, Coquille, and Sixes subbasins. Indian lands are excluded from the critical habitat.

Lower Columbia River ESU
Critical habitat for this ESU is currently in progress. Areas under consideration include watersheds in the lower Columbia River basin in southwest Washington and northwest Oregon, as well as watersheds in Puget Sound and the Strait of Juan de Fuca in Washington.

6.3.6.3 Life history and ecology

Coho spend the first part of their life rearing and feeding on plankton and insects in streams and small freshwater tributaries. After about a year and a half, juveniles migrate to the sea where they forage for small fishes in estuarine and marine waters of the Pacific Ocean. Adults migrate from the marine environment back to the freshwater streams and rivers of their birth in order to mate. They spawn only once and then die, usually at around three years old. Some precocious males known as "jacks" return as two-year-old spawners. Females prepare several redds (nests) where the eggs will remain for 6-7 weeks until they hatch (NMFS s).

6.3.6.4 Population trends and risks

The long term trend for the listed populations is still downward, though there was one recent good year with an increasing trend in 2001 (NMFS s). For threats to population recovery, see the introduction to the Salmonids section.

6.3.7 Chum salmon

The Columbia River and summer-run Hood Canal ESU’s were both listed as threatened on August 2, 1999 (64 FR 41835).

6.3.7.1 Species range

Chum salmon have the widest natural geographic distribution of all Pacific salmon species, ranging in Asia from Korea to the Russian Arctic coast and west to the Lena River, and in North America from Monterey, California, to the Arctic coast and east to the Mackenzie River (Beaufort Sea). Historically, they may have constituted up to 50 percent of the annual biomass of the seven species of Pacific salmon in the North Pacific Ocean (Salo, 2003).

The Hood Canal summer-run ESU includes summer-run chum salmon populations in Hood Canal in Puget Sound and in Discovery and Sequim Bays on the Strait of Juan de Fuca. It may also include summer-run fish in the Dungeness River, but the existence of that run is uncertain. Distinctive life-history and genetic traits were the most important factors in identifying this ESU. Hood Canal summer-run chum salmon are defined as fish that spawn from mid-September to mid-October in the mainstems of rivers (Johnson et al.,1997).

Chum salmon of the Columbia River ESU spawn in tributaries and in mainstem areas below Bonneville Dam. Most fish spawn on the Washington side of the Columbia River. Previously, chum salmon were reported in almost every river in the lower Columbia River basin, but most runs disappeared by the 1950s (Johnson et al., 1997). Currently, only a few natural populations in the basin are regularly monitored: one in Grays River, two in small streams near Bonneville Dam, and the mainstem area next to one of the latter two streams. Recently, spawning has occurred in the mainstem Columbia River at two spots near Vancouver, Washington, and in Duncan Creek below Bonneville Dam (USEPA, 2007).

6.3.7.2 Critical habitat

Critical habitat for both listed chum salmon ESUs (Columbia River and Hood Canal summer-run) was most recently designated on September 2, 2005 (70 FR 52630) and includes areas in Washington and Oregon as described below. A map of critical habitat areas is shown in Figure 6.11. Indian lands are excluded from these critical habitat designations.

Hood Canal Summer-run ESU

Critical habitat includes parts of the Skokomish, Hood Canal, Puget Sound, and Dungeness/Elwha subbasins. It also encompasses all nearshore marine areas (including areas adjacent to islands) of Hood Canal and the Strait of Juan de Fuca (to Dungeness Bay) from the line of extreme high tide out to a depth of 30 meters, except any areas subject to an approved Integrated Natural Resource Management Plan or associated with Department of Defense easements or right-of-ways.

Columbia River ESU

Critical habitat includes parts of the Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Lower Cowlitz, and Lower Columbia subbasins as well as the Lower Columbia River Corridor.

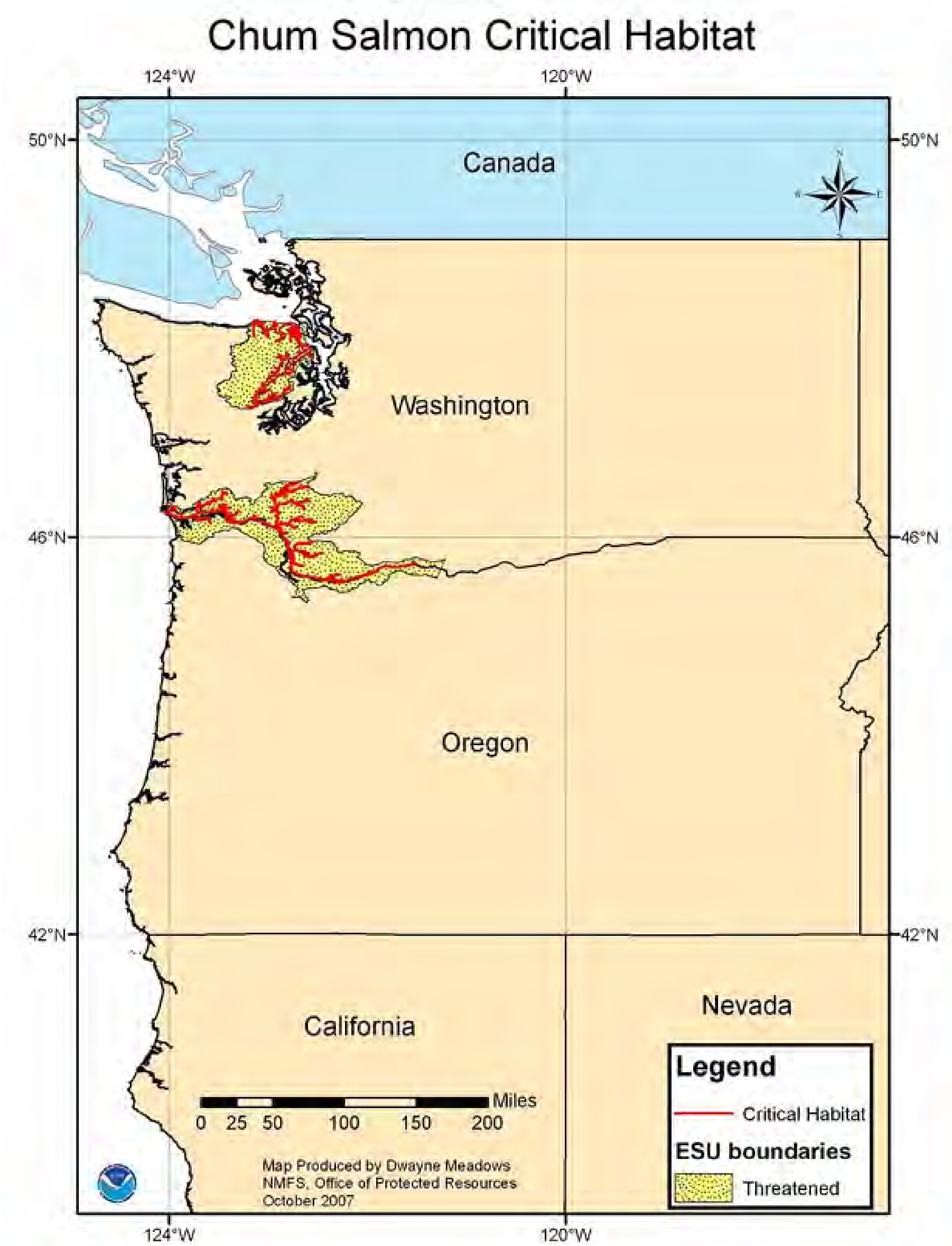

Figure 6.11 Critical Habitat for Chum Salmon (Source: http://www.nmfs.noaa.gov)

6.3.7.3 Life history and ecology

Hood Canal summer-run chum salmon are defined as fish that spawn from mid-September to mid-October. Fry emerge from February to June. In Washington, chum may reside in freshwater for as long as a month before migration to estuarine habitats where they remain for about a month before migrating to deeper water (Johnson et al.,1997). Very few summer-run chum salmon have been artificially propagated in Hood Canal, and the only releases in recent years have been from newly established restoration programs. These recent releases totaled about 241,000 chum salmon fry into Hood Canal in 1993 and 1994 and about 85,000 fry into Discovery Bay on the Strait of Juan de Fuca in 1992. There has been little artificial propagation of summer chum salmon from the Strait of Juan de Fuca east of the Elwha River. Since 1992 a restoration egg box program has produced about 85,000 fry annually in Salmon Creek, a tributary to Discovery Bay. There are no records of summer-run chum salmon fry plants into other streams that enter the Strait of Juan de Fuca, including Jimmycomelately and Snow Creeks, or the Dungeness River (Johnson et al.,1997).

Chum salmon enter the Columbia River from mid-October through early December and spawn from early November to late December. For the last 100 years hatcheries have produced chum salmon for the purpose of increasing stocks. Movement of eggs and fry from one geographical region to another has occurred. Most of the stock transfers in Washington have occurred from chum salmon hatcheries in Hood Canal to streams and hatcheries in south and north Puget Sound, and the Strait of Juan de Fuca. Although these transfers ceased in the early 1980's, hatchery strains (with the Hood Canal chum salmon gene pools) are still being used at some hatcheries and wild populations may have been mixed with hatchery strains at the hatchery and through straying. Recently, the hatching of chum salmon in small stream-side incubators has become popular with volunteer groups. When eggs are provided from hatchery sources, these projects have the potential to disrupt historic patterns of genetic diversity (Johnson et al.,1997).

6.3.7.4 Population trends and risks

Chum salmon may historically have been the most abundant of all Pacific salmonids. Seven of 16 historical spawning populations in the Hood Canal Summer-run ESU are extinct. Recently some of these populations have shown encouraging increases in numbers, but NOAA's June 2005 status review report shows that the population trend overall is a 6% decline per year (NMFS r).

In the Columbia River, historical populations reached hundreds of thousands to a million adults each year. In the past 50 years, the average has been a few thousand a year. Currently, it is thought that 14 of the 16 spawning populations in the Columbia River ESU are extinct. About 500 spawners occur in the ESU presently, and the long-term trend is flat (NMFS r).

For threats to population recovery, see the introduction to the Salmonids section.

6.3.8 Sockeye salmon

There are seven sockeye salmon (*Oncorhynchus nerka*) ESUs, two of which are listed under the ESA. The Snake River ESU was listed as endangered on January 3, 1992 (57 FR 212). The Ozette Lake ESU was listed as threatened on March 25, 1999 (64 FR 14529). These listings were reaffirmed on June 28, 2005 (70 FR 37160) and again following a five-year review on August 15, 2011 (76 FR 50448).

6.3.8.1 Species range

On the Pacific coast, sockeye salmon inhabit riverine, marine, and lake environments from the Klamath River and its tributaries north and west to the Kuskokwim River in western Alaska. As they generally require lakes for part of their life cycle, their distribution in river systems depends on the presence of usable lakes in the system, and thus can be more intermittent than for other Pacific salmon (NMFS p).

The only remaining anadromous sockeye in the Snake River system are found in Redfish Lake, on the Salmon River. The non-anadromous form (kokanee) found in Redfish Lake and elsewhere in the Snake River basin is included in the ESU. Snake River sockeye were historically abundant in several lake systems of Idaho and Oregon. However, all populations have been extirpated in the past century, except fish returning to Redfish Lake (USEPA, 2007).

The Ozette Lake ESU includes all naturally spawned populations of sockeye salmon in Ozette Lake, WA and streams and tributaries flowing into this lake, as well as two artificial propagation programs (NOAA b).

6.3.8.2 Critical habitat

Sockeye salmon critical habitat is shown below in Figure 6.12, followed by descriptions for each ESU.

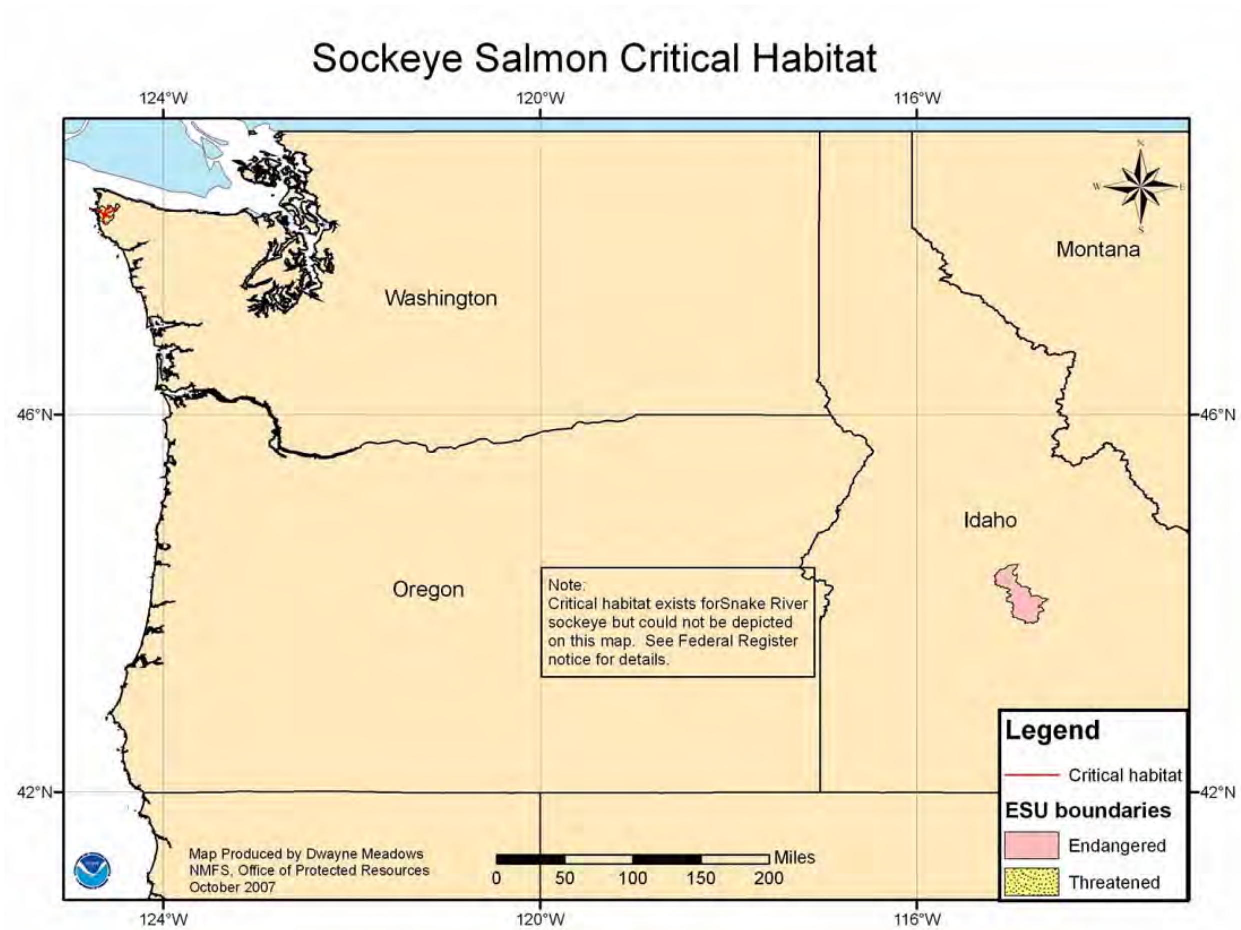

Figure 6.12 Critical Habitat for Sockeye Salmon (Source: http://www.nmfs.noaa.gov)

<u>Ozette Lake ESU</u>
Critical habitat for the Ozette Lake sockeye salmon ESU was designated on February 16, 2000 (65 FR 7764). It encompasses presently or historically accessible reaches of all rivers (including estuarine areas and tributaries) within the range of each ESU, which includes all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Indian lands are excluded from this critical habitat designation.

A slight revision to this ESU's critical habitat was designated on September 2, 2005. The final area includes the Ozette Lake and river reaches within the Ozette Lake Watershed, which comprises a small portion of the Hoh/Quillayute Subbasin.

<u>Snake River ESU</u>
Critical habitat for the Snake River sockeye salmon ESU was designated on December 28, 1993 (58 FR 68543) in parts of Washington, Oregon and Idaho. It is comprised of the water, waterway bottom, and adjacent riparian zone of all river lakes and reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams) to Snake River sockeye salmon in the following hydrologic units: Lower Salmon, Lower Snake, Lower Snake-Asotin, Lower Snake-Tucannon, Middle Salmon-Chamberlain, Middle Salmon-Panther, and Upper Salmon

Critical habitat includes the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake Rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks); Alturas Lake Creek, and that portion of Valley Creek between Stanley Lake Creek and the Salmon River.

6.3.8.3 Life history and ecology

Sockeye spend approximately the first half of their life cycle rearing in lakes. The remainder of the life cycle is spent foraging in estuarine and marine waters of the Pacific Ocean. They migrate from a marine environment into freshwater streams and rivers or lakes of their birth in order to mate; they spawn only once and then die; females spawn in 3 to 5 redds (nests).

In freshwater, they feed on aquatic insects and plankton; in the ocean, they eat amphipods, copepods, squid, and some fishes.

6.3.8.4 Population trends and risks

Sockeyes are the third most abundant species of Pacific salmon, after pink salmon and chum salmon. However, the Snake River ESU has remained at very low levels of only a few hundred fish, though there have been recent increases in the number of hatchery reared fish returning to spawn. Data quality for the Ozette Lake ESU makes differentiating between the number of hatchery and natural spawners difficult, but in either case the size of the population is small, though possibly growing (NMFS p). For threats to population recovery, see the introduction to the Salmonids section.

6.3.9 Steelhead

Eleven of the fifteen Distinct Population Segments (DPSs) of steelhead (*Oncorhynchus mykiss*) found along the US West Coast are listed under the ESA. Six of these have spawning grounds in Washington and Oregon. The Lower Columbia River, Middle Columbia River, Upper Columbia River, Snake River Basin, and Upper Willamette River DPSs were designated as threatened on January 5, 2006 (71 FR 834). The Puget Sound DPS was designated as threatened on May 11, 2007 (72 FR 26722).

6.3.9.1 Species range

In the United States, steelhead trout are found along the entire Pacific Coast. Worldwide, steelhead are naturally found in the Western Pacific south through the Kamchatka peninsula. They have been introduced worldwide (NMFS u).

6.3.9.2 Critical habitat

There are eleven populations of steelhead that are listed as Threatened or Endangered, six of which have critical habitat in Oregon and Washington. Specific critical habitat areas are described below for each population, followed by a composite map in Figure 6.13.

Puget Sound Steelhead

Critical habitat designation for the Puget Sound steelhead is in progress. The areas under consideration include watersheds in the lower Columbia River basin in southwest Washington and northwest Oregon, as well as watersheds in Puget Sound and the Strait of Juan de Fuca in Washington.

Critical habitat was designated for the remaining five of Oregon and Washington listed steelhead on September 2, 2005 (70 FR 52630). Indian lands are excluded from critical habitat for these populations. Specific areas for each population are listed below.

Lower Columbia River steelhead

Critical habitat includes parts of the Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette subbasins. It also includes the Columbia River from the mouth at the Pacific Ocean upstream to a line connecting the confluences of the Sandy River in Oregon and the Washougal River in Washington.

Middle Columbia River steelhead

Critical habitat includes parts of the Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, and Upper Columbia/Priest Rapids subbasins. It also includes the Columbia River from the mouth at the Pacific Ocean upstream to the confluence of the Wind River.

Upper Columbia River steelhead

Critical habitat includes parts of the Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and the Upper Columbia/Priest Rapids subbasins. It also includes the Columbia River from the mouth at the Pacific Ocean upstream to the confluence of the Yakima River.

Snake River Basin steelhead

Critical habitat includes parts of the Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grande Ronde River, Wallowa River, Lower Grande Ronde, Lower Snake/Tucannon, Upper

Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon-Chamberlain, South Fork Salmon, Lower Salmon, Little Salmon, Upper Selway, Lower Selway, Lochsa, Middle Fork Clearwater, South Fork Clearwater, and Clearwater subbasins. It also includes the Columbia River from the mouth at the Pacific Ocean upstream to the confluence of the Snake and Palouse rivers.

Upper Willamette River steelhead

Critical habitat includes parts of the Upper Willamette, North Santiam, South Santiam, Middle Willamette, Yamhill, Molalla/Pudding, and Tualatin subbasins. It also includes the Columbia River from the mouth at the Pacific Ocean upstream to the confluence of the Clackamas and Willamette rivers, including the Multnomah Channel portion of the lower Willamette River.

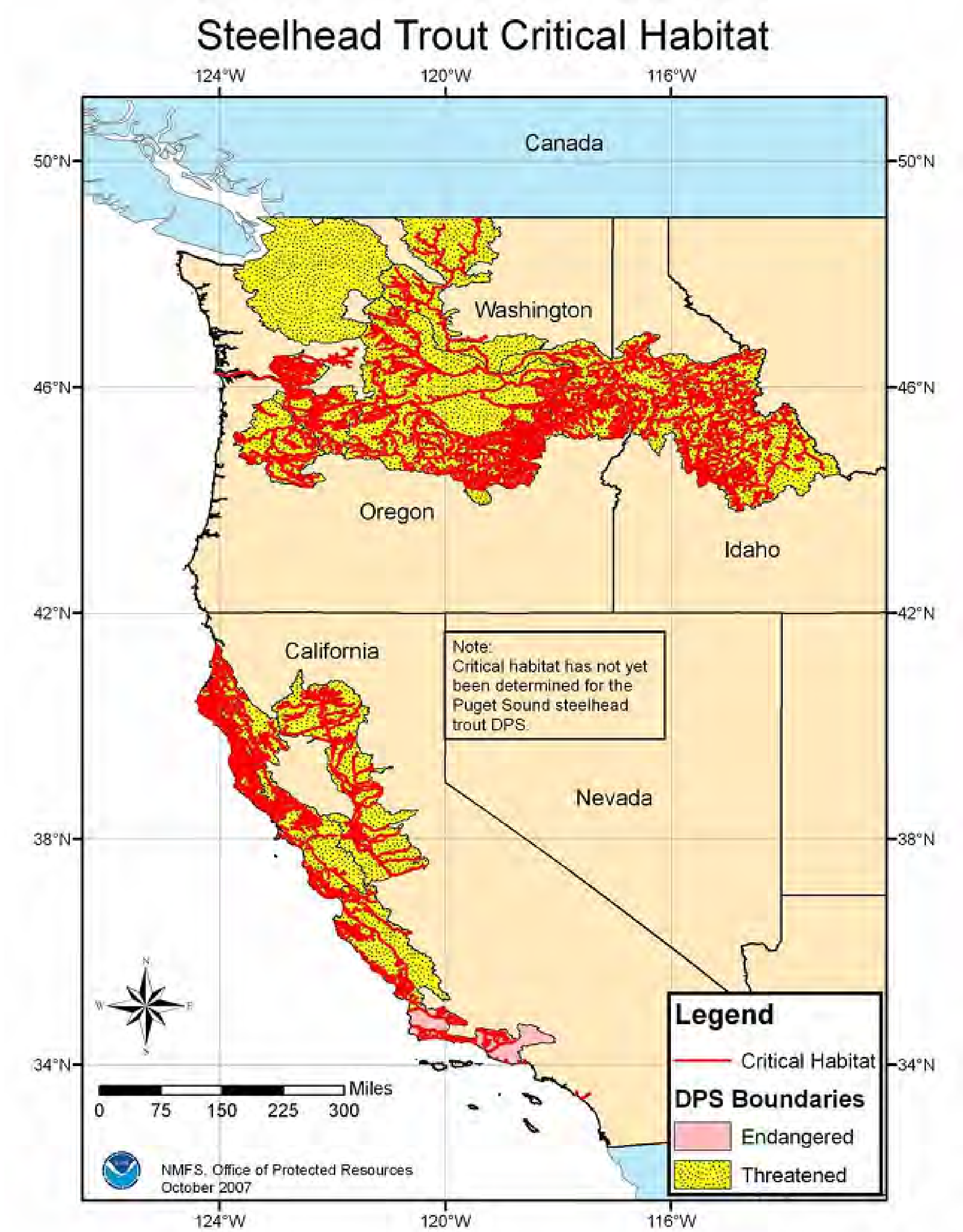

Figure 6.13 Critical Habitat for Steelhead
(Source http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm)

6.3.9.3 Life history and ecology

O. mykiss are a unique species; individuals develop differently depending on their environment. While all hatch in gravel-bottomed, fast-flowing, well-oxygenated rivers and streams, some stay in fresh water all their lives. These fish are called rainbow trout. The steelhead that migrate to the ocean develop a slimmer profile, become more silvery in color, and typically grow much larger than the rainbow trout that remain in fresh water.

Adult steelhead migrate from a marine environment into the freshwater streams and rivers of their birth in order to mate. Unlike other Pacific salmonids, they can spawn more than one time. Migrations can be hundreds of miles.

Young animals feed primarily on zooplankton. Adults feed on aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes (including other trout).

Maximum age is about 11 years. Males mature generally at 2 years and females at 3 years. Juvenile steelhead may spend up to 7 years in freshwater before migrating to estuarine areas as smolts and then into the ocean to feed and mature. They can then remain at sea for up to 3 years before returning to freshwater to spawn. Some populations actually return to freshwater after their first season in the ocean, but do not spawn, and then return to the sea after one winter season in freshwater. Timing of return to the ocean can vary, and even within a stream system there can be different seasonal runs.

Steelhead can be divided into two basic reproductive types, based on the state of sexual maturity at the time of river entry and duration of spawning migration. The stream-maturing type (summer-run steelhead in the Pacific Northwest and northern California) enters freshwater in a sexually immature condition between May and October and requires several months to mature and spawn. The ocean-maturing type (winter-run steelhead in the Pacific Northwest and northern California) enters freshwater between November and April, with well-developed gonads, and spawns shortly thereafter. Coastal streams are dominated by winter-run steelhead, whereas inland steelhead of the Columbia River basin are almost exclusively summer-run steelhead.

Adult female steelhead will prepare a redd (or nest) in a stream area with suitable gravel type composition, water depth, and velocity. The adult female may deposit eggs in 4 to 5 "nesting pockets" within a single redd. The eggs hatch in 3 to 4 weeks (NMFS u).

6.3.9.4 Population trends and risks

In recent years, some populations have shown encouraging increases in population size while others have not (NMFS u). For threats to population recovery, see the introduction to the Salmonids section.

6.3.10 North American green sturgeon

The North American green sturgeon was officially divided into two Distinct Population Segments by the NMFS on January 29, 2003 (68 FR 4433). The Southern DPS, which includes any coastal or Central Valley, CA populations south of the Eel River in California (the only known population being in the Sacramento River), was listed as Threatened on April 7, 2006 (71 FR 17757).

6.3.10.1 Species range

Green sturgeon are the most broadly distributed, wide-ranging, and most marine-oriented species of the sturgeon family. The green sturgeon ranges from Mexico to at least Alaska in marine waters, and is observed in bays and estuaries up and down the west coast of North America (Moyle et al., 1995).

6.3.10.2 Critical habitat

Critical habitat for the Southern DPS of North American green sturgeon was designated on October 9, 2009 (74 FR 52300). Shown in Figure 6.14, it includes freshwater riverine areas, bays and estuaries, and coastal marine areas.

All of the freshwater riverine parts of the critical habitat are in California; there are none in Oregon or Washington.

Coastal bays and estuaries included in the critical habitat designation include Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay in Oregon; Willapa Bay and Grays Harbor in Washington; and the Lower Columbia River estuary in both states. Critical habitat in bays and estuaries includes tidally influenced areas as defined by the elevation of mean higher high water. The boundary between coastal marine areas and bays and estuaries are delineated by the COLREGS lines (33 CFR 80).

The marine portion of the critical habitat includes all U.S. coastal marine waters out to the 60 fm (110 m) depth bathymetry line (relative to MLLW) from Monterey Bay, California north and east to include waters in the Strait of Juan de Fuca, Washington. The Strait of Juan de Fuca includes all U.S. marine waters: in Clallam County east of a line connecting Cape Flattery, Tatoosh Island, and Bonilla Point, British Columbia; in Jefferson and Island counties north and west of a line connecting Point Wilson and Partridge Point; and in San Juan and Skagit counties south of lines connecting the U.S.-Canada border and Pile Point, Cattle Point and Davis Point, and Fidalgo Head and Lopez Island. Critical habitat in coastal marine areas is defined by the zone between the 60 fm depth bathymetry line and the line on shore reached by mean lower low water (MLLW), or to the COLREGS lines.

The primary constituent elements of nearshore coastal marine critical habitat areas that are essential for the conservation of the Southern DPS of green sturgeon are:

- (i) Migratory corridor: a migratory pathway for the safe and timely passage within marine and between estuarine and marine habitats.
- (ii) Water quality: nearshore marine waters with adequate dissolved oxygen levels and acceptably low levels of contaminants (e.g., pesticides, organochlorines, elevated levels of heavy metals) that may disrupt the normal behavior, growth, and viability of subadult and adult green sturgeon.
- (iii) Food resources: abundant prey items for subadults and adults, which may include benthic invertebrates and fishes.

Certain areas in the Strait of Juan de Fuca and Whidbey Island, Washington that are owned or controlled by the Department of Defense, or designated for its use, are excluded from critical habitat.

All Indian lands of the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw as well as the Coquille Indian Tribe in Oregon; and the Hoh, Jamestown S'Klallam, Lower Elwha, Makah, Quileute, Quinault, and Shoalwater Bay Tribes in Washington are excluded from critical habitat designation.

Figure 6.14 Critical Habitat for Green Sturgeon (Source: http://www.nmfs.noaa.gov)

6.3.10.3 Life history and ecology

Green sturgeon are long-lived, slow-growing fish. Mature males range from 4.5-6.5 feet (1.4-2 m) in "fork length" and do not mature until they are at least 15 years old (Van Eenennaam, 2002), while mature females range from 5-7 feet (1.6-2.2 m) fork length and do not mature until they are at least 17 years old. Maximum ages of adult green sturgeon are likely to range from 60-70 years (Moyle, 2002).

Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Early life-history stages reside in fresh water, with adults returning to freshwater to spawn when they are more than 15 years of age and more than 4 feet (1.3 m) in size. Spawning is believed to occur every 2-5 years (Moyle, 2002). Adults typically migrate into fresh water beginning in late February; spawning occurs from March-July, with peak activity from April-June (Moyle et al., 1995). Females produce 60,000-140,000 eggs (Moyle et al., 1992). Juvenile green sturgeon spend 1-4 years in fresh and estuarine waters before dispersal to saltwater (Beamsesderfer and Webb, 2002). They disperse widely in the ocean after their out-migration from freshwater (Moyle et al., 1992).

The only available feeding data on adult green sturgeon shows that they eat benthic invertebrates including shrimp, mollusks, amphipods, and even small fish (Moyle et al., 1992).

6.3.10.4 Population trends and risks

No good data on current population sizes exists and data on population trends is lacking. The principal factor in the decline of the Southern DPS is reduction of the spawning area to a limited section of the Sacramento River. Other threats to the Southern DPS include insufficient freshwater flow rates in spawning areas, contaminants (e.g., pesticides), bycatch of green sturgeon in fisheries, potential poaching (e.g., for caviar), entrainment by water projects, influence of exotic species, small population size, impassable barriers (dams) to spawning grounds, and elevated water temperatures (NMFS o).

6.4 THREATENED AND ENDANGERED BIRDS

6.4.1 Marbled murrelet

The marbled murrelet (*Brachyramphus marmoratus*) was federally listed as Threatened under the Endangered Species Act on October 1, 1992 (57 FR 45328).

6.4.1.1 Species range

The marbled murrelet, a small sea bird that nests in the coastal old-growth forests of the Pacific Northwest, inhabits the Pacific coasts of North America from the Bearing Sea to central California. In contrast to other seabirds, murrelets do not form dense colonies, and may fly 70km or more inland to nest, generally in older coniferous forests. They are more commonly found inland during the summer breeding season, but make daily trips to the ocean to gather food, primarily fish and invertebrates, and have been detected in forests throughout the year. When not nesting, the birds live at sea, spending their days feeding and then moving several kilometers offshore at night (SEI, 1999).

6.4.1.2 Critical habitat

Critical habitat was initially designated for marbled murrelets on May 24, 1996 (61 FR 26251). The primary constituent elements essential to support successful reproduction of the species include individual trees with potential nest platforms and forest lands of at least one half site-potential tree height regardless of contiguity within 0.8 kilometers (0.5 miles) of individual trees with potential nesting platforms and that are used or potentially used by the marbled murrelet for nesting or roosting.

A downsized critical habitat was designated on October 5, 2011; portions of Oregon and California critical habitat were removed, while Washington critical habitat remained unchanged.

The current designation encompasses 3,698,100 inland and coastal acres in Washington, Oregon and California (76 FR 61599). Critical habitat in Washington is shown in Figure 6.15, and critical habitat in Oregon is shown in Figure 6.16.

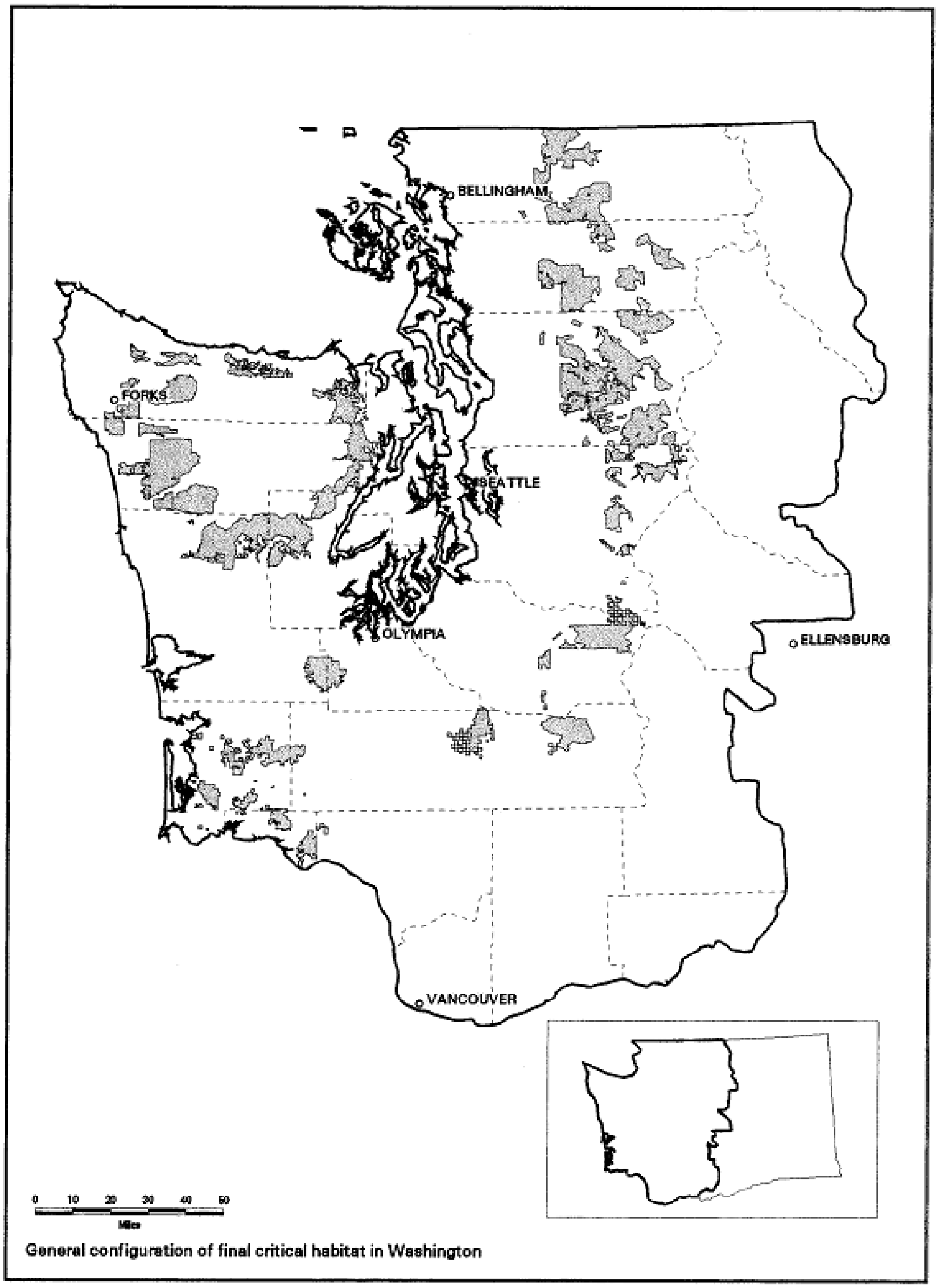

Figure 6.15 Critical Habitat for the Marbled Murrelet in Washington (Source: 61 FR 26279)

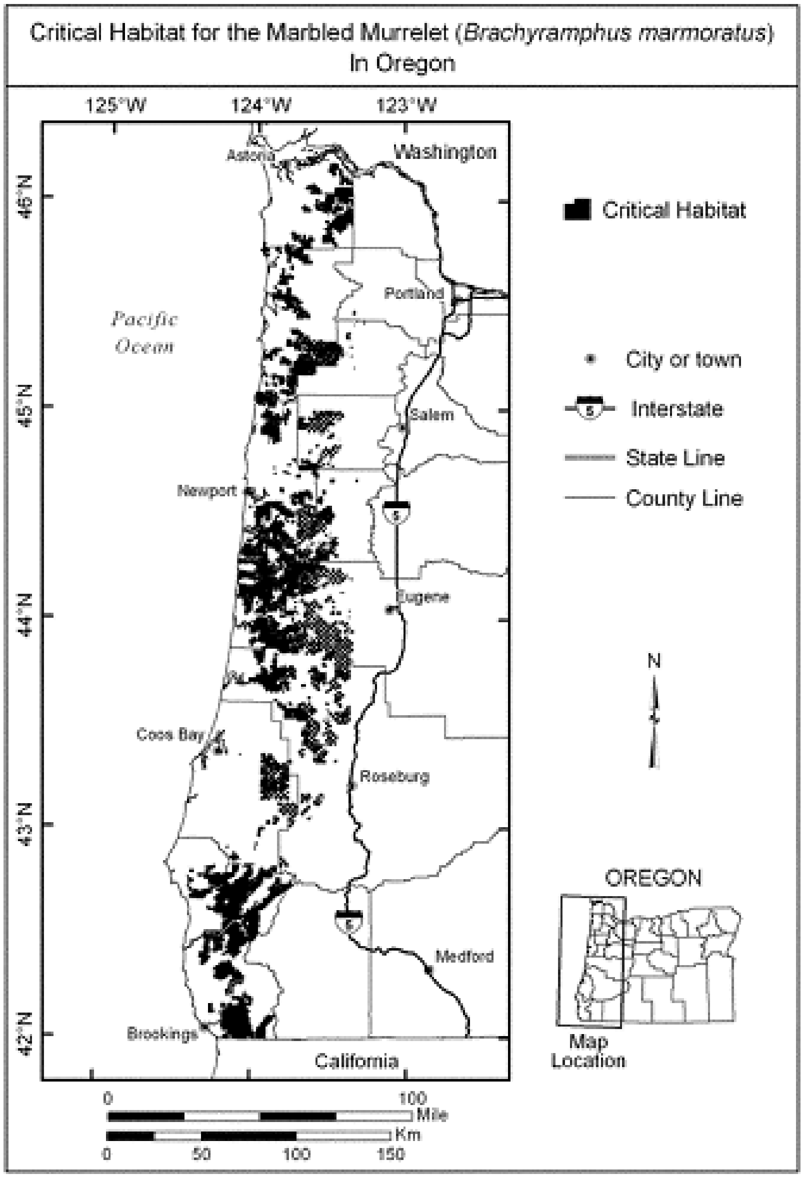

Figure 6.16 Critical Habitat for the Marbled Murrelet in Oregon (Source: 61 FR 26280)

6.4.1.3 Life history and ecology

The breeding season of the marbled murrelet generally begins in April, with most egg laying occurring in late May and early June. Peak hatching occurs in July after a 27- to 30-day incubation. Chicks remain in the nest and are fed by both parents. By the end of August, chicks have fledged and dispersed from nesting areas. The marbled murrelet differs from other seabirds in that its primary nesting habitat is old-growth coniferous forest within 50 to 75 miles of the coast. The nest typically consists of a depression on a moss-covered branch where a single egg is laid. Marbled murrelets appear to exhibit high fidelity to their nesting areas, and have been observed in forest stands for up to 20 years. Marbled murrelets have not been known to nest in other habitats including alpine forests, bog forests, scrub vegetation, or scree slopes (Marks and Bishop, 1999).

Marbled murrelets are presumably long-lived species but are characterized by low fecundity (one egg per nest) and low nesting and fledging success. Fledging success has been estimated at 45 percent. Nest predation on both eggs and chicks appears to be higher for marbled murrelets than for other alcids, and may be cause for concern. Principal predators are birds, primarily corvids (jays, ravens, and crows) (Marks and Bishop, 1999).

At sea, foraging murrelets are usually found as widely spaced pairs. In some instances murrelets form or join flocks that are often associated with river plumes and currents. These flocks may contain sizable portions of local populations (Ralph and Miller, 1999).

6.4.1.4 Population trends and risks

The total North American population of marbled murrelets is estimated to be 360,000 individuals. Approximately 85 percent of this population breeds along the coast of Alaska. Estimates for Washington, Oregon, and California vary between 16,500 and 35,000 murrelets (Ralph and Miller, 1999). In British Columbia, the population was estimated at 45,000 birds in 1990 (Environment Canada, 1999). In recent decades the murrelet population in Alaska and British Columbia has apparently suffered a marked decline, by as much as 50 percent. Between 1973 and 1989, the Prince William Sound, Alaska, murrelet population declined 67 percent. Trends in Washington, Oregon, and California are also down, but the extent of the decrease in unknown. Current data suggest an annual decline of at least 3 to 6 percent throughout the species' range (Ralph and Miller, 1999).

The most serious limiting factor for marbled murrelets is the loss of habitat through the removal of old-growth forests and fragmentation of forests. Forest fragmentation may be making nests near forest edges vulnerable to predation by other birds such as jays, crows, ravens, and great-horned owls (USFWS 1996). Entanglement in fishing nets is also a limiting factor in coastal areas due to the fact that the areas of salmon fishing and the breeding areas of marbled murrelets overlap. The marbled murrelet is especially vulnerable to oil pollution; in both Alaska and British Columbia, it is considered the seabird most at risk from oil pollution. In 1989, an estimated 8,400 marbled murrelets were killed as a result of the Exxon Valdez oil spill (Marks and Bishop, 1999). Marbled murrelets forage in nearshore waters where recreational boats are most often found. Disturbance by boats may cause them to abandon the best feeding areas (Environment Canada, 1999).

6.4.2 Short-tailed Albatross

The short-tailed albatross (*Phoebastria albatrus*) was originally listed in 1970, under the Endangered Species Conservation Act of 1969, prior to the passage of today's Endangered Species Act (35 FR 8495). However, as a result of an administrative error (and not from any biological evaluation of status), the species was listed as endangered throughout its range except within the United States (50 CFR 17.11). On July 31, 2000, this error was corrected when the Service published a final rule listing the short-tailed albatross as endangered throughout its range (65 FR 46643).

6.4.2.1 Species range

The range of the short-tailed albatross includes most of the North Pacific Ocean as shown in Figure 6.1. The species occurs throughout international waters and within the Exclusive Economic Zones (EEZ) of Mexico, the United States, Canada, and other nations in the North Pacific.

As of 2008, 80-85% of the known breeding short-tailed albatross use a single colony, Tsubamezaki, on Torishima Island, an active volcano located off the coast of Japan. The rest breed in the Senkaku Islands in the East China Sea. Both islands are shown in Figure 6.17.

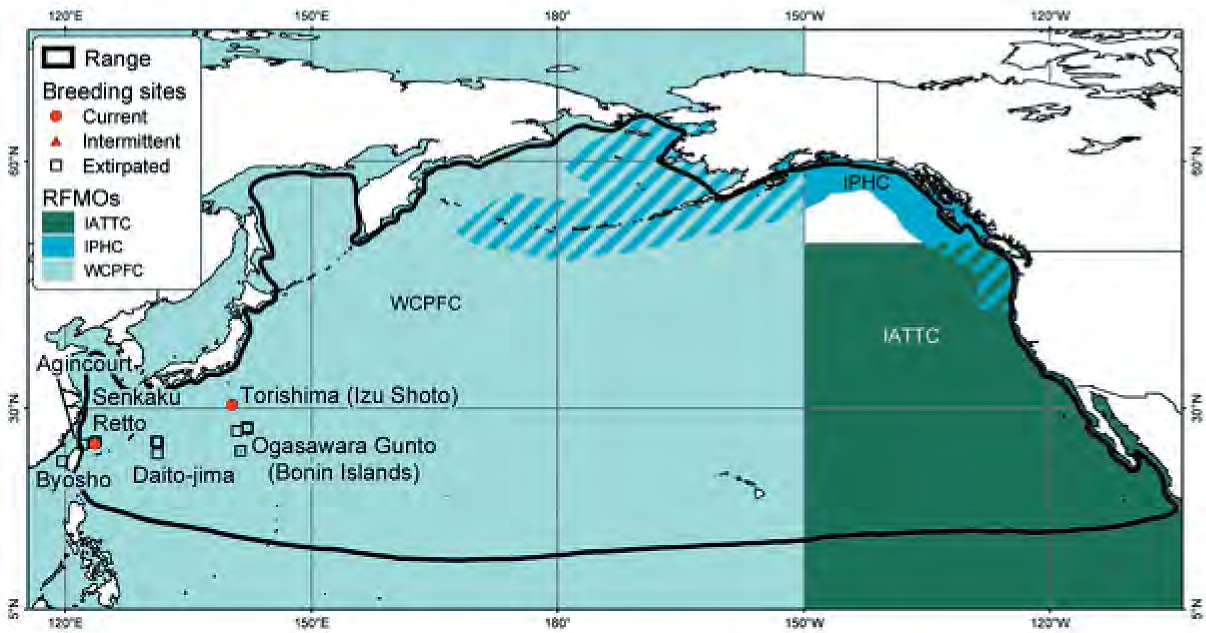

Figure 6.17 Range and Breeding Sites of the Short Tailed Albatross (USFWS, 2008)

6.4.2.2 Critical habitat

Critical habitat has not been designated for this species. In the 2000 final rule, the Service determined that designation of Critical Habitat was not prudent due to the lack of habitat-related threats to the species, the lack of specific areas in U.S. jurisdiction that could be identified as meeting the definition of Critical Habitat, and the lack of recognition or educational benefits accruing to the American people as a result of such designation (USFWS, 2008).

6.4.2.3 Life history and ecology

Like many seabirds, short-tailed albatrosses are slow to reproduce and are long-lived, with some known to be over 40 years old. They begin breeding at about 7 or 8 years, and mate for life. Short-tailed albatrosses nest on sloping grassy terraces on two rugged, isolated, windswept islands in Japan. Pairs lay a single egg each year in October or November. Eggs hatch in late December through early January. Chicks remain near the nest for about 5 months, fledging in June. After breeding, short-tailed albatrosses move to feeding areas in the North Pacific. When feeding, albatrosses alight on the ocean surface and seize their prey, including squid, fish, and shrimp (USFWS, 2001).

6.4.2.4 Population trends and risks

Millions of short-tailed albatross were harvested by feather hunters prior to and following the turn of the 20th century, resulting in the near-extinction of the species by the mid-20th century. In June, 2008, about 2400 of these birds were known to exist, with about 450-500 breeding pairs (USFWS, 2008). The major threat of over-exploitation that led to the species' original endangered status no longer occurs. The most notable existing threat to the species' recovery is the possibility of an eruption of Torishima, their main breeding site. Other existing threats include incidental catch in commercial fisheries, ingestion of plastics, contamination by oil and other pollutants, the potential for depredation or habitat degradation by non-native species, and adverse effects related to global climate change (USFWS, 2008).

6.5 THREATENED AND ENDANGERED REPTILES

6.5.1 Green sea turtle

The green sea turtle (*Chelonia mydas*) was listed under the ESA on July 28, 1978 (43 FR 32800). Breeding colony populations in Florida and on Mexico's Pacific Coast are listed as Endangered. All other populations are considered to be Threatened.

6.5.1.1 Species range

The green turtle is globally distributed and generally found in tropical and subtropical waters along continental coasts and islands between 30° North and 30° South. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south. Nesting occurs in over 80 countries, but none is known to occur in U.S. Pacific waters (NMFS h).

6.5.1.2 Critical habitat

Although they have been sighted along the entire Pacific Coast, the green sea turtle is largely restricted to tropical and sub-tropical waters. Critical habitat for the green sea turtle as designated on September 2, 1998 (63 FR 46693) only includes waters surrounding Isla de Culebra, Puerto Rico. There is no critical habitat for this species along the Pacific Coast of the United States.

6.5.1.3 Life history and ecology

Except when migrating, green turtles are generally found in fairly shallow waters inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting. Green turtles apparently have strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches. Hatchlings have been observed to seek refuge and food in Sargassum rafts. Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae (USFWS a).

The nesting season varies with the locality. In the Southeastern U.S., it is roughly June through September. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. A female may lay as a many as nine clutches within a nesting season (overall average is about 3.3 nests per season) at about 13-day intervals. Clutch size varies from 75 to 200 eggs, with an average clutch size of 136 eggs reported for Florida. Incubation ranges from about 45 to 75 days, depending on incubation temperatures. Hatchlings generally emerge at night. Age at sexual maturity is believed to be 20 to 50 years (USFWS a).

6.5.1.4 Population trends and risks

Analysis of historic and recent abundance information by the Marine Turtle Specialist Group (MTSG) indicates that extensive population declines have occurred in all major ocean basins over approximately the past 100-150 years. The MTSG analyzed population trends at 32 index nesting sites around the world and found a 48-65% decline in the number of mature females nesting annually during that time period (NMFS h).

The principal cause of the historical, worldwide decline of the green turtle is long-term harvest of eggs and adults on nesting beaches and juveniles and adults on feeding grounds. These harvests continue in some areas of the world and compromise efforts to recover this species. Incidental capture in fishing gear is another serious ongoing source of mortality that adversely affects the species' recovery. Green turtles are also threatened in some areas of the world by a disease known as fibropapillomatosis (NMFS h).

Another major threat to all marine turtles is ingestion of or entanglement in marine debris such as tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear. Other marine hazards include environmental contamination from coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise, and boat and vessel strikes (NMFS v).

6.5.2 Leatherback sea turtle

The leatherback sea turtle (*Dermochelys coriacea*) was included in the first list of endangered species under the Endangered Species Conservation Act on June 2, 1970 (35 FR 8491).

6.5.2.1 Species range

Leatherbacks are the most migratory and wide ranging of sea turtle species. They are commonly known as pelagic (open ocean) animals, but they also forage in coastal waters. Adult leatherbacks are capable of tolerating a wide range of water temperatures, and have been sighted along the entire west coast of the United States. Nesting grounds are located around the world, with the largest remaining nesting assemblages found on the coasts of northern South America and west Africa. The U.S. Caribbean and southeast Florida support minor nesting colonies, but they represent the most significant nesting activity within the United States (NMFS i).

6.5.2.2 Critical habitat

The original critical habitat for the leatherback sea turtle, designated on September 26, 1978, only included certain areas around the U.S. Virgin Islands (43 FR 43688). Additional areas located in the Pacific Ocean were added on January 26, 2012 (77 FR 4170). This designation includes approximately 16,910 square miles (43,798 square km) along the California coast from Point Arena to Point Arguello east of the 3,000 meter depth contour; and 25,004 square miles (64,760 square km) from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour. The designated areas, shown in Figure 6.18, comprise approximately 41,914 square miles (108,558 square km) of marine habitat and include waters from the ocean surface down to a maximum depth of 262 feet (80 m).

The primary constituent element essential for conservation of leatherback turtles is the occurrence of prey species, primarily scyphomedusae (jellyfish) of the order Semaeostomeae, of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

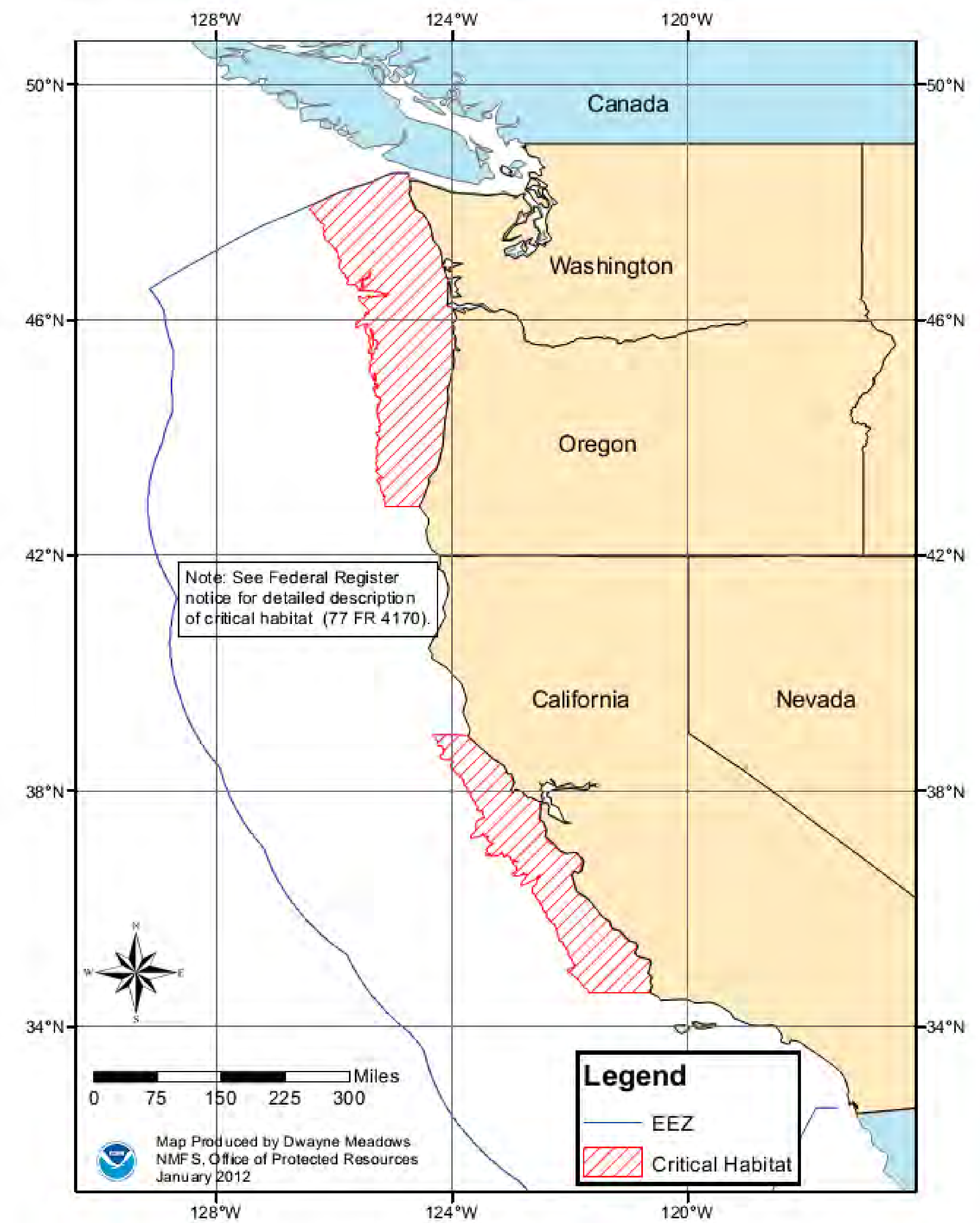

Figure 6.18 Leatherback Sea Turtle Critical Habitat (Source: NMFS)

6.5.2.3 Life history and ecology

The leatherback is the largest turtle and the largest living reptile in the world. It is the only sea turtle that lacks a hard, bony shell. Their mouths are adapted for a diet of soft-bodied pelagic prey, such as jellyfish and salps. Leatherbacks mate in the waters adjacent to nesting beaches and along migratory corridors. Females lay clutches of approximately 100 eggs on sandy, tropical beaches. They nest several times during a nesting season, typically at 8-12 day intervals. Hatchlings emerge from the nest after 60-65 days. After nesting, female leatherbacks migrate from tropical waters to more temperate latitudes, which support high densities of jellyfish prey in the summer (NMFS i).

6.5.2.4 Population trends and risks

The Pacific Ocean leatherback population is generally smaller in size than that in the Atlantic Ocean. Because adult female leatherbacks frequently nest on different beaches, nesting population estimates and trends are especially difficult to monitor. In the Pacific, the International Union for Conservation of Nature (IUCN) notes that most leatherback nesting populations have declined more than 80%. In other areas of the leatherback's range, observed declines in nesting populations are not as severe, and some population trends are increasing or stable. Nesting trends on U.S. beaches have been increasing in recent years (NMFS i).

Leatherback turtles face threats on both nesting beaches and in the marine environment. The greatest causes of decline and the continuing primary threats to leatherbacks worldwide are long-term harvest and incidental capture in fishing gear. Harvest of eggs and adults occurs on nesting beaches while juveniles and adults are harvested on feeding grounds. Incidental capture primarily occurs in gillnets, but also in trawls and other types of gear. Together these threats are serious ongoing sources of mortality that adversely affect the species' recovery (NMFS i).

Another major threat to all marine turtles is ingestion of or entanglement in marine debris such as tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear. Other marine hazards include environmental contamination from coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise, and boat and vessel strikes (NMFS v).

6.5.3 Loggerhead sea turtle

The loggerhead sea turtle (*Caretta caretta*) was designated as threatened throughout its worldwide range on July 28, 1978 (43 FR 32800). On September 22, 2011 nine Distinct Population Segments were identified, of which five were listed as endangered, including the North Pacific Ocean DPS (76 FR 58868).

6.5.3.1 Species range

Loggerheads are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. They are the most abundant species of sea turtle found in U.S. coastal waters. In the eastern Pacific, loggerheads have been reported as far north as Alaska, and as far south as Chile. In the U.S., occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. The only known nesting areas for loggerheads in the North Pacific are found in southern Japan (NMFS j).

6.5.3.2 Critical habitat

Critical habitat has not yet been designated for loggerhead sea turtles.

6.5.3.3 Life history and ecology

Loggerhead turtles feed on whelks and conch. They occupy three different ecosystems during their lives: (1) beaches (terrestrial zone), (2) water (oceanic zone), and (3) nearshore coastal areas ("neritic" zone).

Females nest on ocean beaches from April-September and generally lay three to five nests during a single season. The eggs incubate approximately two months before hatching sometime between late June and mid-November.

Immediately after hatchlings emerge from the nest, they begin a period of frenzied activity during which they move to the surf, are swept through the surf zone, and continue swimming away from land for up to several days. After this swim frenzy period, post-hatchling loggerheads take up residence in areas where surface waters converge to form local downwellings. These areas are often characterized by accumulations of floating material, such as seaweed.

As post-hatchlings, loggerheads may linger for months in waters just off the nesting beach or may be transported by ocean currents into the oceanic zone. Somewhere between 7-12 years old, oceanic juveniles migrate to nearshore coastal areas (neritic zone) and continue maturing until adulthood (NMFS j).

6.5.3.4 Population trends and risks

The most recent reviews show that only two loggerhead nesting beaches have greater than 10,000 females nesting per year: South Florida (U.S.) and Masirah Island (Oman). Total estimated nesting in the U.S. is approximately 68,000 to 90,000 nests per year. Recent analyses of nesting data from the Index Nesting Beach Survey program in southeast Florida show the population is declining. Similarly, long-term nesting data show loggerhead nesting declines in North Carolina, South Carolina, and Georgia.

Loggerheads face threats on both nesting beaches and in the marine environment. The greatest cause of decline and the continuing primary threat to loggerhead turtle populations worldwide is incidental capture in fishing gear, primarily in longlines and gillnets, but also in trawls, traps and pots, and dredges. Directed harvest for loggerheads still occurs in many places (for example, the Bahamas, Cuba, and Mexico) and is a serious and continuing threat to loggerhead recovery (NMFS j).

Another major threat to all marine turtles is ingestion of or entanglement in marine debris such as tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear. Other marine hazards include environmental contamination from coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise, and boat and vessel strikes (NMFS v).

6.5.4 Olive Ridley sea turtle

The olive or Pacific ridley sea turtle (*Lepidochelys olivacea*) was listed as threatened on July 28, 1978. At the same time, breeding populations on the Mexican Pacific Coast were designated as endangered (43 FR 32800).

6.5.4.1 Species Range

Olive ridleys are globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. In the Eastern Pacific Ocean, they occur from Southern California to Northern Chile. Olive ridleys often migrate great distances between feeding and breeding grounds (NMFS k).

6.5.4.2 Critical habitat
No critical habitat rules have been published for the Olive Ridley sea turtle.

6.5.4.3 Life history and ecology
Adult olive ridleys are relatively small compared to other sea turtles, weighing on average 100 pounds. Nesting females are 22-31 inches long. The size varies from region to region, with the largest animals being observed on the Pacific coast of Mexico. Olive ridleys reach sexual maturity around 15 years. This turtle has what is considered one of the most extraordinary nesting habits in the natural world. Large groups of females gather off shore of nesting beaches. Then, all at once, hundreds to thousands come ashore to lay their eggs in what is known as an "arribada." Females nest every year, once or twice a season, laying clutches of approximately 100 eggs. Incubation takes 50-60 days (NMFS k).

6.5.4.4 Population trends and risks
The olive ridley is considered the most abundant sea turtle in the world, with an estimated 800,000 nesting females annually; however, it may also be the most exploited. According to the Marine Turtle Specialist Group (MTSG) of the IUCN, there has been a 50% reduction in population size since the 1960s, when the olive ridley fishery developed in Mexico and Ecuador. Although some nesting populations have increased in the past few years, the overall reduction is greater than the overall increase. Degradation of nesting beaches, ongoing directed harvest of both eggs and turtles, and bycatch in fisheries have all contributed to the decline of the species. All of these factors continue to be a threat in at least some parts of the world (NMFS k).

Another major threat to all marine turtles is ingestion of or entanglement in marine debris such as tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear. Other marine hazards include environmental contamination from coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise, and boat and vessel strikes (NMFS v).

6.6 EFFECT OF PERMITTED DISCHARGES ON THREATENED AND ENDANGERED SPECIES

This section summarizes potential effects on threatened and endangered species of discharges by offshore seafood processors covered under the Draft Permit. There have been limited studies directed at evaluating these impacts; however, it is possible to make inferences based on species life history as described above and the information in Section 5.

The primary concern of the proposed seafood processing waste is a short term chemical and physical change in the water column. This potential change decreases over time and with distance from the outfall. Some of the dissolved constituents of the discharge, such as disinfectants, could be toxic to marine organisms, but should be in low levels and dissipate quickly. Chemical reactions, including reductions in dissolved oxygen, could result from constituents in the discharge as well as byproducts formed during the decomposition of seafood wastes. The potential effects of discharges, therefore, could occur as direct or indirect impacts, including exposure to decreased water quality, alterations in abundance and composition of food source communities, habitat degradation, and increased predation.

6.6.1 Marine Mammals
Of the eight threatened and endangered marine mammals likely to be found within the Draft Permit action area, two have had critical habitat designated. None of the designated critical

habitat for these species intersects with the Draft Permit action area. North Pacific right whale critical habitat is in the Bering Sea and the Gulf of Alaska. Southern Resident killer whale critical habitat is found in inland waters of Washington.

Guadalupe fur seals could be harmed by oil on their fur if they were to come into contact with surface oil residue. However, oil from seafood processing should be minimal per Draft Permit restrictions. Furthermore, the Guadalupe fur seals do not usually extend as far north as Oregon and Washington.

The threatened and endangered marine mammals are relatively large in size, which would lessen the direct impact of localized seafood processing discharge plumes on individual animals. These mammals are highly mobile and therefore able to avoid discharge areas. However, fish-eating species might be attracted to discharge as a food source. This would put them at increased risk of vessel strike or predation. This attraction could also create dependence on an anthropogenic food supply which might run out, and could habituate the animals to humans, potentially increasing danger to them if they are perceived as a nuisance.

None of the marine mammals mentioned in this section rely on phytoplankton as a food source. Therefore, the effects of seafood processing waste discharge on phytoplankton community abundance and structure, as described in Section 5, would only have indirect impacts on these marine mammals. If zooplankton abundance is affected indirectly by changes in the phytoplankton community or directly by the discharge itself, mammals such as the baleen whale species (right, sei, blue, fin, and humpback whales) that feed on zooplankton could be indirectly affected. Species such as killer whales and sperm whales that feed at a higher trophic level are less likely to be impacted.

Habitat degradation, depletion of prey, and aquatic pollution are considered to be threats to all threatened and endangered marine mammals. Impacts due to seafood processing waste are limited to the immediate vicinity of the discharge, and the receiving waters are sufficiently oxygenated and well-mixed to allow for dispersion and dilution of pollutants, therefore, effects on these species are likely to be minor.

6.6.2 Fish

Several threatened and endangered fish species are likely to occur within the Draft Permit action area, including three rockfish species, Pacific eulachon, five salmonids species, and North American green sturgeon. Offshore seafood processing discharges have the potential to directly impact these species, particularly at vulnerable life stages, to indirectly impact them due to alteration of prey abundance, and to have a harmful effect on critical habitat for one species, the North American green sturgeon.

Because no threatened or endangered fish lay eggs in this area of the ocean, there is no danger of burial or suffocation of demersal eggs under waste piles. The only larval species found in the ocean are rockfish and eulachon. Due to their small size and reliance on currents for transport, these are the most susceptible to water quality effects of offshore seafood processing discharge such as hypoxia, turbidity, and presence of disinfectants. Salmonids and sturgeon remain in fresh water and estuaries for a few months to a few years, depending on the species, before migrating to the open ocean. Juvenile and adult fish are mobile and thus able to avoid discharge plumes as necessary.

There is potential for indirect impacts of seafood processing discharge to fish if their prey is affected. Rockfish larvae could suffer if abundance of the phytoplankton they consume is reduced due to eutrophication or if primary production is shifted from beneficial to harmful types of algae. Zooplankton could experience altered respiratory or feeding ability or be indirectly affected by alteration of the phytoplankton community. This would affect eulachon and juveniles of most other species, which feed on zooplankton. Adult salmonids are less likely to be affected as they prey on higher trophic organisms such as squid and other fish. Adult rockfish and green sturgeon feed on benthic invertebrates and small demersal fish, which could be impacted by anoxic zones associated with accumulated waste on the seafloor.

Some fish species might be attracted to seafood processing discharge as a food source, with several potentially harmful results. First, it would put them at increased risk of toxic effects due to reduced water quality in the vicinity of the waste. Second, it could put them at increased risk of predation. Third, it could create dependence on an anthropogenic food supply which might run out. Finally, proximity to fishing vessels could increase the risk to these species of being caught as bycatch.

No critical habitat has been designated for the rockfish. Critical habitat for eulachon and all salmonids only includes freshwater and estuarine areas. Critical habitat for the green sturgeon, however, includes all U.S. coastal marine waters out to the 60 fm (110 m) depth bathymetry line (relative to MLLW) off the coasts of Washington and Oregon. The western part of this critical habitat intersects with the eastern part of the action area, as the 3 nm line delineating the boundary between state and federal waters is almost entirely in waters that are shallower than 60 fm. Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. However, the extent of its critical habitat within the action area warrants a discussion of the potential impacts to this species and its critical habitat.

The three primary constituent elements of green sturgeon critical habitat are a safe migratory corridor, adequate water quality, and sufficient food resources, as described in Section 6.3.10.2. Safe migration is not expected to be affected by offshore seafood processing waste discharge. Discharge could result in reduced dissolved oxygen levels and increased levels of contaminants such as chlorine byproducts. This deterioration of water quality could disrupt the normal behavior, growth, and viability of green sturgeon. As discussed above, disruptions to the benthic communities these fish feed on caused by seafood processing discharge could indirectly affect green sturgeon by decreasing food abundance.

The primary threats to recovery of threatened and endangered anadromous fish are generally considered to be disruptions in spawning paths and degradation or loss of spawning grounds, often associated with water storage, conveyance, and withdrawal projects. Another threat to both anadromous and marine fish is overharvest, both directly and as bycatch. Nonetheless, reduction in water quality and prey abundance due to offshore discharge could potentially cause negative impacts on these species, particularly in earlier life stages.

Seafood processing waste is discharged in high tidal activity areas which allow for adequate dispersion and dilution, therefore, effects on habitat and prey of these fish species should be minimal.

6.6.3 Birds

Of the two ESA listed birds discussed in this section, only the marbled murrelet has designated critical habitat, and it does not include any offshore areas. The marbled murrelet and short-tailed albatross are likely to be found within the Draft Permit action area.

Potential impacts from seafood processing discharge to surface feeders are primarily related to floating wastes. The marbled murrelet is especially vulnerable to oil pollution; it poses a threat to the short-tailed albatross as well. The Draft Permit prohibits the occurrence of substances that float as debris, scum, oil, or other matter to form nuisances on the surface. It also requires surface waters to be virtually free from floating nonpetroleum oils of vegetable or animal origin, as well as petroleum-derived oils. These protections should ensure that these birds are not likely to be directly harmed by oil.

Sea birds may be attracted to discharge plumes as a food source and, therefore, be at increased risk of toxic effects of the discharge. This is less likely to impact marbled murrelets, as they tend to feed in nearshore areas. Sea birds could also be indirectly affected by seafood processing waste if abundance of fish and other prey is disrupted due to eutrophication and related effects.

Seafood processing waste discharges are localized and limited to well-mixed waters in order to allow for dispersion and dilution of pollutants, and the Draft Permit prohibits the occurrence of substances that float as debris, scum, oil, or other matter to form nuisances on the surface, therefore, potential impacts to threatened and endangered sea birds are likely to be minimal.

6.6.4 Reptiles

Of the four marine turtle species discussed in Section 6.5, only two (leatherback and loggerhead) are likely to be found within the Draft Permit action area. Green sea turtles and olive ridleys prefer subtropical and tropical waters over the colder waters found in the EEZ off of Washington and Oregon. Loggerheads have been reported as far north as Alaska and as far south as Chile in the eastern Pacific. In the U.S., occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. Leatherbacks have a global range; they are primarily pelagic but also forage in coastal waters, and follow their prey to temperate waters in the summer. Therefore it is highly likely that leatherbacks will be found in the Draft Permit action area, and moderately likely that loggerheads will be found there. No known sea turtle nesting sites are located in the Draft Permit action area.

The leatherback turtle is the only listed reptile that has designated critical habitat within the action area. The 25,004 square mile (64,760 square km) section of critical habitat that extends from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour covers approximately 20% of the action area.

The primary constituent element essential for conservation of leatherback turtles is the sufficient availability of prey species, primarily scyphomedusae (jellyfish). Jellyfish are not expected to be directly affected by seafood processing discharge, although the lower trophic species on which they feed, such as plankton and small crustaceans, could be affected, resulting in indirect impacts to jellyfish and thus to leatherbacks.

If turtles are attracted to discharge plumes as a food source, this would increase risk of incidental capture and vessel strikes. Indirect effects to prey species of sea turtles due to eutrophication are possible. Environmental contamination is considered a minor threat to the recovery of all four ESA listed turtles.

Since the Draft Permit only allows seafood processing waste discharge to high tidal activity areas, and the receiving waters are sufficiently oxygenated and well-mixed to allow for dispersion and dilution of pollutants, effects on prey and habitat of these sea turtles are likely to be minimal.

6.7 SUMMARY

Species listed under the ESA that are likely to occur in waters that are included in the Draft Permit include marine mammals, fish, birds, and turtles. Limited research on the impacts of seafood processing waste discharges on these species means the impacts are generally unknown. However, it is possible to make inferences based on species life history and information on the potential impacts to marine organisms.

Discharges could have direct or indirect impacts including exposure to decreased water quality, alterations in abundance, and composition of food source communities, habitat degradation, and increased predation. Most marine mammals, fish, and turtles are highly mobile and therefore able to swim out of possible harm's way. The exception to this is rockfish and eulachon larvae. Also, seafood processing discharges can present a food source or can change the dynamic of the presence of other species foraging on the waste that may influence the endangered or threatened species.

The Draft Permit prohibits the occurrence of substances that float as debris, scum, oil, or other matter to form nuisances on the sea surface and thereby eliminate potential impact of oil on species foraging on the waste. Since, seafood processing wastes are discharged in high tidal activity areas which allows for adequate dispersion and dilution, and impacts to receiving waters are localized, effects on habitat and prey are likely to be minor.

SECTION 7.0

COMMERCIAL AND RECREATIONAL FISHING

The determination of "unreasonable degradation" of the marine environment is to be made based upon consideration of the ten criteria listed in Section 1.0. This section provides information pertinent to consideration of the ocean discharge criteria shown below:

Criterion #7: "Existing or potential recreational and commercial fishing, including finfishing and shellfishing"

This section will assist in evaluating criterion #7 by briefly describing the commercial and recreational fisheries in the Draft Permit action area, and discussing the potential impacts that seafood processing waste discharges may have on these activities.

The management of marine resources in the Draft Permit action area is vested in the Pacific Fishery Management Council (PFMC or Council), one of eight regional councils established by the Fishery Conservation and Management Act of 1976. It is a stakeholder body that formally advises the National Marine Fisheries Service (NMFS) on management of fisheries in federal waters off Oregon, Washington and California.

This area sustains several important fisheries, including groundfish, salmon, coastal pelagic species, halibut, and highly migratory species. Table 7.1 presents species which are managed by the PFMC. Information each sector is presented below.

Table 7.1 Fisheries Located in the Continental U.S. Pacific EEZ

Category	Species
Groundfish (91)	Rockfish (64 species)
	Flatfish (12 species)
	Roundfish (6 species)
	Sharks & Skates (6 species)
	Other (3 species)
Salmon (3)	Chinook
	Coho
	Puget Sound Pink
Coastal Pelagic Species (5)	Northern anchovy
	Pacific sardine
	Pacific (chub) mackerel
	Jack mackerel
	Market squid
Highly Migratory Species (13)	Sharks (5 species)
	Tunas (5 species)
	Striped marlin
	Broadbill swordfish
	Dorado (mahimahi)

7.1 GROUNDFISH

7.1.1 Managed Groundfish Species

Groundfish generally live on or near the bottom of the ocean. The PFMC manages 91 species, including:

- **Rockfish**. The plan covers 64 different species of rockfish, including widow, yellowtail, canary, shortbelly, and vermilion rockfish; bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch.
- **Flatfish**. The plan covers 12 species of flatfish, including various soles, starry flounder, turbot, and sanddab.
- **Roundfish**. The six species of roundfish included in the fishery management plan are lingcod, cabezon, kelp greenling, Pacific cod, Pacific whiting (hake), and sablefish.
- **Sharks and skates**. The six species of sharks and skates are leopard shark, soupfin shark, spiny dogfish, big skate, California skate, and longnose skate.
- **Other species**. These include ratfish, finescale codling, and Pacific rattail grenadier.

Many groundfish feed on a variety of benthic invertebrates, such as worms, mollusks, and crustaceans. Juveniles often feed on demersal eggs and larvae, but may be planktivorous. Depending on the species, some groundfish prey on other fish, including some pelagic fish. Many are opportunistic feeders, so specific food sources depends on availability (PFMC, 2005b).

7.1.2 The Pacific Groundfish Fishery

Since there is such a wide variety of groundfish, many different gear types are used to target them. While the trawl fishery harvests most groundfish, they can also be caught with troll, longline, hook and line, pots, gillnets, and other gear (PFMC c).

The West Coast groundfish fishery is comprised of four components:

- **Limited entry**. This component is comprised of fishers with limited entry permits. This program limits the number of vessels allowed to participate in a fishery. This sector is, in turn, divided into limited entry trawl (for those fishers using trawl gear such as bottom and pelagic trawl nets) and limited entry fixed gear (for those fishers using fixed gear, such as longlines, traps or pots). Most of the Pacific coast commercial groundfish harvest is taken by the limited entry fleet.
- **Open access**. This component of the groundfish fishery allocates a portion of the harvest to fishers targeting groundfish without limited entry permits, and fishers who target non-groundfish fisheries that incidentally catch groundfish. Trawl gear may not be used in the directed groundfish open access fishery. Trawl gear for target species such as pink shrimp, California halibut, ridgeback prawns, and sea cucumbers are exempted from this rule.
- **Recreational**. This component includes anglers targeting groundfish species and others who target non-groundfish species but who incidentally take groundfish. Marine recreational fisheries consist of charter vessels, private vessels, and shore anglers. Charter vessels are larger vessels for hire, which typically fish farther offshore than most vessels in the private recreational fleet.

- **Tribal**. This component is made up of tribal commercial fishers who have a federally recognized treaty right to fish for federally managed groundfish in their “usual and accustomed” fishing areas. These tribes, all located in Washington state, include the Quinault, Hoh, Quileute, and Makah. Formal allocations to these tribes exist for sablefish and Pacific whiting. Other groundfish species allocations for this sector are decided by annual Council action (PFMC c). Management of tribal fisheries is conducted by the individual tribes in accordance with their tribal regulations.

7.1.3 Recent Fishery Statistics

The Pacific whiting fishery is the largest component of the West Coast groundfish fishery. A description of this fishery can be found in Section 2.1. Pacific whiting accounted for 87% of the total catch of PFMC-managed groundfish by weight in 2005. Landings in the whiting sector reached 244,548 mt in 2005, up from a low in 2003 of 139,646 mt. The limited entry fixed gear had its lowest landings in 2002 at 2,188 mt. The directed open access sector had its lowest landings in 2004 at 1,215 mt. Recreational fisheries also saw the lowest landings in 2004 at 1,987 mt. The decline in such landings mirrors the status of the groundfish stocks and efforts to rebuild overfished species (PFMC, 2008).

7.1.4 Groundfish Fishery Management

PFMC’s Pacific Coast Groundfish Fishery Management Plan (FMP) contains the rules for managing the groundfish fishery. It outlines the areas, species, regulations, and methods that the Council and the Federal government must follow to make changes to the fishery. The plan also creates guidelines for the biennial management process.

Groundfish are managed through a number of measures including harvest guidelines, quotas, trip and landing limits, area restrictions, seasonal closures, and gear restrictions (such as minimum mesh size for nets and small trawl footrope requirements for fishing shoreward of the trawl Rockfish Conservation Area (RCAs are areas where fishing is prohibited to specific gears or sectors). Rationalization of the trawl sector of the groundfish fishery was implemented in early 2011. This process, which involves shifting to an Individual Fishing Quota (IFQ) and harvest co-operative program, is expected to reduce harvest capacity in the fishery, to make the fishery more efficient, and to lower bycatch (the incidental harvest of non-target species). All sectors of the groundfish fishery are currently constrained by the need to rebuild groundfish species that have been declared overfished (widow rockfish, canary rockfish, yelloweye rockfish, darkblotched rockfish, bocaccio, Pacific ocean perch, and cowcod). Rebuilding plans have been developed to help these species recover. Because of the low available harvest of species managed under rebuilding plans, the overall groundfish harvest has been significantly reduced (PFMC c).

The Council reviews management performance (i.e., total fishing-related mortality, including landings plus discard mortalities) and socioeconomic impacts relative to management objectives (e.g., rebuilding plans) during the two-year management period in order to consider modifying harvest specifications and management measures in the next biennial management period. New assessment results are also considered when deciding biennial harvest specifications and management measures. Pacific whiting are managed annually, with harvest levels set each year under the terms of the U.S.-Canada Pacific whiting Treaty (PFMC c).

7.2 SALMON

The PFMC has managed salmon fisheries in the EEZ (3 to 200 nm offshore) off the coasts of Washington, Oregon and California since 1977 through Fishery Management Plans (FMPs).

The PFMC is directed by the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267) to prevent overfishing while achieving optimal yield.

Fisheries in PFMC-managed waters harvest primarily Chinook and coho salmon. In odd-numbered years, the Council may manage special fisheries near the Canadian border for pink salmon (because pink salmon mature and spawn on a strict 2-year cycle, there is distinct genetic isolation between odd- and even-year spawners). There are no directed fisheries for sockeye, chum and steelhead, which are rarely caught in Council-managed waters (PFMC b).

Salmon are affected by a wide variety of factors in the ocean and on land, including ocean and climatic conditions, dams, habitat loss, urbanization, agricultural and logging practices, water diversion, and predators (including humans). Salmon are an important source of spiritual and physical sustenance for Northwest Indian tribes, and they are symbolically important to many other residents of the Northwest (PFMC b).

7.2.1 Species Descriptions

Chinook salmon (*Oncorhynchus tshawytscha*) are also called king, spring, or tyee salmon, and are the largest of the Pacific salmon. They are highly prized by commercial, sport, and subsistence fishers. Like all Pacific salmon, Chinook are anadromous, which means they hatch in freshwater streams and rivers, migrate to the ocean for feeding and growth, and return to their natal waters to spawn. Within this life history, Chinook can be very diverse. Their spawning environments range from just above tidewater to over 3,200 kilometers from the ocean. The natural range of Chinook in North America spans from the Ventura River in California to Kotzebue Sound in Alaska. They also appear in Asia, from northern Japan to the Andyr River in Russia (about 64 degrees north latitude). In the ocean, Chinook from Washington, Oregon and California range widely throughout the Pacific Ocean and the Bering Sea, and as far south as the U.S. border with Mexico. Wild Chinook populations have disappeared from large areas where they used to flourish, and several evolutionarily significant units (ESUs) have been listed or proposed for listing as at risk for extinction under the Endangered Species Act (PFMC b). Chinook salmon feed on terrestrial and aquatic insects, amphipods, and other crustaceans while young, and primarily on other fishes when older (NMFS t).

Coho or “silver” salmon (*Oncorhynchus kisutch*) are found in streams and rivers throughout much of the Pacific Rim, from central California to Korea and northern Japan. Coho are also anadromous and have a life history similar to Chinook. However, the time they spend in fresh and salt water is relatively fixed, compared to the more variable life history of Chinook. North of central British Columbia, coho tend to spend two years in the ocean, while south of this point they spend only one year in the ocean. Unlike Chinook, where most production comes from mainstem spawning areas, coho tend to use smaller streams and tributaries. North American coho spawn in tributaries from the San Lorenzo River in Monterey Bay, California to Point Hope, Alaska, and throughout the Aleutian Islands. They are most abundant in coastal areas from central Oregon to southeast Alaska (PFMC b). In their freshwater stages, coho feed on plankton and insects, and switch to a diet of small fishes as adults in the ocean (NMFS s).

7.2.2 The Pacific Salmon Fishery

Salmon are fished in the open ocean, in coastal bays, and freshwater rivers. The ocean portion of the fishery consists of three sectors: commercial non-Indian troll, treaty Indian troll, and recreational (PFMC b). Both the commercial and recreational salmon fisheries have suffered substantial declines relative to harvest levels of the 1980s (PFMC, 2012b).

7.2.3 Recent Fishery Statistics

Total 2011 ex-vessel (before processing) value of the Council-managed non-Indian commercial salmon fishery was $9.2 million, the highest total since 2007, largely thanks to the California segment. This value was 41 percent above the 2006-2010 inflation-adjusted average of $6.5 million, and 85 percent below the 1979 through 1990 inflation-adjusted average of $60.7 million (PFMC, 2012b).

The preliminary estimate of vessel-based ocean salmon recreational angler trips taken on the West Coast in 2011 was 211,200, an increase of sixteen percent from the previous year, but 65 percent below the 1979 through 1990 average. Compared with 2010, the estimated number of trips taken in 2011 decreased by 9 percent in Oregon and 12 percent in Washington, while increasing in California (PFMC, 2012b).

Total West Coast income impacts associated with recreational and non-Indian commercial ocean salmon fisheries for all three states combined in 2011 were estimated at $31.9 million, the highest level since $41.8 million (adjusted for inflation) in 2007. Of this total, 46% is attributed to the commercial fishery and 54% to the recreational fishery. The 2011 total was 22 percent above the prior year's inflation-adjusted level of $26.1 million and 91 percent below the inflation-adjusted value for 1979 (the highest value in the data time series). The 2011 income impact was the fourth lowest on record; the first, second and third lowest (adjusted for inflation) were recorded in 2008 ($7.5 million), 2009 ($17.9 million), and 2010 ($26.1 million), respectively. Note that these coastwide values may mask effects in particular communities (PFMC, 2012b).

Treaty Indian commercial fisheries off Washington operate under regulations established by the Council. While some of the treaty Indian harvest is for ceremonial and subsistence purposes, the vast majority of the catch is sold commercially. Commercial treaty Indian fisheries provide food to consumers and generate income in local and state economies through expenditures on harvesting, processing, and marketing of the catch. Harvest information for the last three years of the treaty Indian ocean troll fishery is shown in Table 7.2. For 2011 the preliminary ex-vessel value of Chinook and coho landed in the treaty Indian ocean troll fishery was $1.7 million, compared with inflation-adjusted exvessel values of $1.37 million in 2010 and $1.0 million in 2009 (values based on PacFIN data) (PFMC, 2012b).

Table 7.2 Recent Salmon Harvests for Treaty Indian Fisheries in PFMC Waters (Source: PFMC, 2012b)

	Chinook		Coho	
year	number	pounds	number	pounds
2011	34,500	380,300	13,600	77,600
2010	34,200	298,500	11,400	80,000
2009	12,800	103,700	60,600	345,800

7.2.4 Salmon Fishery Management

PFMC's Salmon Fishery Management Plan describes the goals and methods for salmon management. Management tools such as season length, quotas, and bag limits vary depending on how many salmon are present. There are two central parts of the Plan: Conservation objectives, which are annual goals for the number of spawners of the major salmon stocks ("spawner escapement goals"), and allocation provisions of the harvest among different groups of fishers (commercial, recreational, tribal, various ports, ocean, and inland). The Council must also comply with laws and treaties such as the Endangered Species Act, Magnuson-Stevens Act, and the 1985 Pacific Salmon Treaty, which guides allocation of harvest between the West Coast, Canada, and Alaska (PFMC b).

Every year the PFMC follows a preseason process to develop recommendations for management of the ocean salmon fisheries. PFMC publishes recommendations in the spring for that year's fisheries based on analysis of the previous year's harvest and projections about environmental and socioeconomic effects of proposed management alternatives. Regulations enacted by the NMFS based on these recommendations include catch limits, minimum size, and maximum fish per vessel for each species; gear restrictions; and closures based on area, day of the week, and season dates. These regulations are different for commercial, recreational, and tribal fisheries, and also vary by stock and fishery location. Fishing season start dates range from spring through summer, and end dates range from summer to fall. Seasons will end early if the quota for a species is met. Specific information on the 2012 regulations can be found in 77 FR 25915.

Managing the ocean salmon fisheries is an extremely complex task. Salmon migrate extensively when in the ocean. Correctly judging the size of salmon populations is a constant challenge. Salmon are affected by many natural and human-caused factors, so their numbers can vary widely. Estimating the effects of changes in ocean conditions and weather on salmon is difficult, but new research into the relationship between ocean environmental factors and salmon abundance show some promise. Other challenges include coordinating with international, regional, and local agencies and groups; judging the effects of these different regional fisheries on salmon stocks; recovering salmon under the Endangered Species Act; dividing the harvest fairly; and restoring freshwater habitat. Farmed salmon, bycatch, the use of hatcheries, and the differences between wild and hatchery salmon are other hot topics relating to salmon. Genetic stock identification (GSI) techniques are being investigated to see if differences in salmon stocks' ocean distribution can be used to improve management and reduce fishing impacts on stocks of concern (PFMC b).

7.3 COASTAL PELAGIC SPECIES

Coastal pelagic species (CPS) managed by the PFMC include four finfish (northern anchovy, Pacific sardine, Pacific mackerel, and jack mackerel) and one invertebrate (market squid). The finfish are pelagic, generally occurring in the water column as opposed to living near the sea floor. Although market squid spawn in benthic regions, they are considered part of the same species complex because they are fished above spawning aggregations. CPS are found in the EEZs of Canada, Mexico, and the U.S., as well as in international waters (PFMC a).

The pelagic species can generally be found anywhere from the surface to 1,000 meters (547 fm) deep. Pacific sardine and Pacific mackerel are actively managed, meaning landings and markets are substantial enough to warrant annual assessment of stock status and fishery management. The three other species are either managed at the state-level or are landed in low numbers and are therefore monitored for potential elevation to active management in the future (PFMC a).

7.3.1 Species Descriptions

Northern anchovy (*Engraulis mordax*) are small, short-lived fish that are typically found in schools near the surface. They range from British Columbia to Baja California and are divided into northern, central, and southern sub-populations. The central subpopulation used to be the focus of large commercial fisheries in the U.S. and Mexico. Most of this sub-population is located in the Southern California Bight, between Point Conception, California and Point Descanso, Mexico. (The Southern California Bight is an indentation along the coast of southern California that includes coastal southern California, the Channel Islands, and a section of the Pacific Ocean.) Northern anchovy eat phytoplankton and zooplankton and are an important part of the food chain for other species, including other fish, birds, and marine mammals (PFMC a).

Pacific sardine (*Sardinops sagax*) are small planktivorous schooling fish. At times, they have been the most abundant fish species in the California Current Ecosystem. When the population of Pacific sardine is large, it is abundant from the tip of Baja California to southeastern Alaska and throughout the Gulf of California. In the north, sardines tend to appear seasonally. Sardines also form three (and possibly four) sub-populations. The northern subpopulation of sardines, which ranges seasonally from northern Baja California to British Columbia and as far as 300 nm offshore, is most important to U.S. commercial fisheries. Sardines may live as long as 13 years, but they are usually younger than five years old. Like anchovies, they are taken by a wide variety of predators (PFMC a).

Pacific (chub) mackerel (*Scomber japonicus*) range from Mexico to southeastern Alaska. They are most abundant south of Point Conception, California and usually appear within 20 miles offshore. The “northeastern Pacific” stock of Pacific mackerel is harvested by fishers in the U.S. and Mexico. Like sardines and anchovies, mackerel are schooling fish, and they may school with other pelagic species such as jack mackerel and sardines. They are also heavily preyed upon by a variety of fish, mammals, and sea birds (PFMC a). Larvae eat copepods and other zooplankton including fish larvae. Juveniles and adults feed on small fishes, fish larvae, squid and pelagic crustaceans such as euphausiids (PFMC, 1998).

Jack mackerel (*Trachurus symmetricus*) are a schooling fish that range widely throughout the northeastern Pacific. They grow to about 60 cm and can live 35 years or longer. Much of their range lies outside the EEZ. Small jack mackerel (up to six years of age) are most abundant in the Southern California Bight, where they are often found near the mainland coast and islands and over shallow rocky banks. Older, larger fish range from Cabo San Lucas, Baja California to the Gulf of Alaska, where they are generally found offshore in deep water and along the coastline to the north of Point Conception. Large fish rarely appear close to the southern shore. Young juvenile fish sometimes form small schools beneath floating kelp and debris in the open sea. Small jack mackerel taken off southern California and northern Baja California eat large zooplankton, juvenile squid, and anchovy. Larvae feed almost entirely on plankton. The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July. Little is known about the maturity cycle of large fish offshore, but peak spawning appears to occur later in more northerly waters. Large predators like tuna and billfish eat jack mackerel, but adult jack mackerel are probably a minor forage source for smaller predators. Older jack mackerel probably do not contribute significantly to food supplies of marine birds because they are too large to be eaten by most bird species, and they school too deep for birds to reach them. They do not appear to be an important food source for marine mammals (PFMC a).

Market squid (*Loligo opalescens*) appear from the southern tip of Baja California to southeastern Alaska. They are most abundant between Punta Eugenio, Baja California and Monterey Bay, California. They are harvested near the surface, but they can appear to depths of 800 meters or more. They prefer the salinity of the ocean and are rarely found in estuaries, bays, or river mouths. Squid are short-lived (up to ten months). They are important as forage foods to many fish, birds, and mammals, such as king salmon, coho salmon, lingcod, rockfish, seals and sea lions, sea otters, porpoises, cormorants, and murres (PFMC a). Squid feed on copepods as juveniles, gradually changing to euphausiids, other small crustaceans, small fish, and other squid as they grow (PFMC 1998).

7.3.2 The CPS Fishery

Coastal pelagic species are harvested directly and as bycatch in other fisheries. Generally, they are targeted with “round-haul” gear including purse seines, drum seines, lampara nets, and dip nets. These species are also taken incidentally with midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs.

Within the U.S. EEZ, sardines are caught by U.S. commercial fisheries, by party and charter boats, and by anglers. In the 1940s and 1950s, about 200 vessels participated in the Pacific sardine fishery. Some of these boats are still fishing today.

Market squid are fished at night with the use of powerful lights, which attract the squid to the surface. They are either pumped directly from the sea into the hold of the boat, or caught with an encircling net.

Most processors and buyers of CPS on the West Coast are located in California, mainly in Los Angeles, Santa Barbara- Ventura, and Monterey. Some are also located in the Columbia River port areas of Oregon and Washington. Most of the market squid and Pacific sardines caught in the U.S. are exported. Market squid are mainly exported to China, the United Kingdom, Japan, and Spain. Sardines are mainly exported to Japan, where they are used for human consumption and as bait for longline fisheries; and Australia, where they are used to feed farmed bluefin tuna. A very small amount of sardines landed in Oregon and Washington are sold to Portland-area restaurants. Mackerel are exported to Japan, the Philippines, and Malta for human consumption (PFMC a).

7.3.3 Recent Fishery Statistics

Washington, Oregon and California landings of CPS totaled 200,428 mt in 2010, a 19 percent increase from 2009. Market squid accounted for 65 percent and Pacific sardine 33 percent of these landings. All market squid landings occurred in California. Washington and Oregon shares of total west coast CPS landings in 2010 were 6 percent and 11 percent respectively. In 2010, the number of vessels with west coast landings of CPS finfish (species other than squid) was 148, down from 173 in 2009. The ex-vessel revenue from all CPS landings was $84.0 million in 2010, up 18 percent from 2009 (PFMC, 2011a).

7.3.4 CPS Fishery Management

Every June a Stock Assessment and Fishery Evaluation (SAFE) document is presented to the Council along with the current stock assessment for Pacific mackerel. The Council adopts a harvest guideline for the fishery, which runs from July 1 through June 30. In November, as a supplement to the SAFE document, the current stock assessment for Pacific sardine is presented, and the Council adopts a harvest guideline for the January 1 through December 31 fishery (PFMC a).

7.4 HIGHLY MIGRATORY SPECIES

7.4.1 HMS Species

The term “highly migratory species” (HMS) derives from Article 64 of the United Nations Convention on the Law of the Sea. Although the Convention does not provide an operational definition of the term, an annex to it lists species considered highly migratory by parties to the Convention. In general, these species have a wide geographic distribution, both inside and outside countries' 200-mile EEZs, and undertake migrations of significant but variable distances across oceans for feeding or reproduction. They are pelagic species, which means they do not live near the sea floor, and mostly live in the open ocean, although they may spend part of their life cycle in nearshore waters. They are harvested by U.S. commercial and recreational fishers and by foreign fishing fleets. Only a small fraction of the total harvest is taken within U.S. waters (PFMC d).

The PFMC actively manages the following species:

- Tunas: north Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin
- Sharks: common thresher, pelagic thresher, bigeye thresher, shortfin mako, blue
- Billfish/swordfish: striped marlin, Pacific swordfish
- Other: dorado (also known as dolphinfish and mahi-mahi)

Exact diet varies from species to species, but HMS generally feed on a variety of fish, crustaceans and cephalopods. Juveniles may feed on zooplankton and fish larvae (PFMC, 2007).

7.4.2 The HMS Fishery

Except for the swordfish drift gillnet fishery off California, highly migratory species fisheries are among the few remaining open access fisheries on the West Coast. However, some members of the fishing industry are concerned that reductions in other fisheries (like groundfish) could push more people into HMS fisheries, increasing fishing pressure.

As a result of these concerns, the PFMC may consider developing a limited entry program to control excess capacity. The Council adopted a control date of March 9, 2000, in case a limited entry program is needed in the future. This date was announced in the Federal Register as an advance notice to the public that a limited entry program may be adopted, and that any new entrants in the fishery after the control date may not qualify for a permit. The announcement applies to all commercial and charter fisheries for highly migratory species. Control dates are established to minimize the rush of new entrants into a fishery that often occurs when limited entry is being considered. The current Fishery Management Plan does not include a limited entry program, but an amendment to the plan could be developed sometime in the near future to establish one (PFMC d).

Many different gear types are used to catch highly migratory species:

- Troll gear. Trolling involves towing lines with multiple hooks behind a vessel. Fishing lines are rigged to outriggers (trolling poles), which are deployed at about a 45 degree angle from the sea surface. Albacore are usually harvested by trollers with jigs or live bait.

- Drift gillnets. A gillnet is a panel of netting suspended vertically in the water by floats, with weights along the bottom. Fish are entangled in the net. Drift gillnet gear is anchored to a vessel, and drifts along with the current. It is usually used to target swordfish and common thresher shark. Most drift gillnets are used off California, with a small fraction being used off the Oregon coast. The drift gillnet fishery is heavily regulated by the states of California and Oregon and by the federal government. This gear is not legal in Washington. Measures to protect sea turtles from drift gillnets were put in place in 2001.

- Harpoon. The harpoon fishery mainly targets swordfish, and mostly takes place in California. Harpoons used to be the primary method of harvesting swordfish until the drift gillnet fishery became popular in the 1980s. There are only a few vessels still using harpoons. Harpoons are not legal gear in Washington.
- Pelagic longline. Pelagic longline gear consists of a main horizontal line that has shorter lines with baited hooks attached to it. The gear is used at various depths and at different times of day, depending on the species being targeted. Longliners from Hawaii currently target swordfish and tuna on the high seas. However, West Coast longliners are prohibited from fishing in the EEZ or targeting swordfish anywhere, due to concerns about the take of endangered sea turtles. Hawaii longliners operate under a regulatory framework mandating gear modifications and operating procedures, including limits on the number of sets they may make, to reduce the take of sea turtles when targeting swordfish. If a similar framework were implemented for West Coast vessels they too could target swordfish.
- Coastal purse seine. A purse seine is an encircling net that is closed by means of a purse line threaded through rings on the bottom of the net. This gear is effective in catching schooled tunas. “Coastal” purse seiners are smaller vessels that fish close to the California shore. They mainly harvest coastal pelagic species (sardines, anchovies, mackerel), but they also fish for bluefin and other tunas when they are available.
- Large purse seine. Large purse seine gear is used in major fisheries in the eastern tropical Pacific and the central and western Pacific. This fishery is monitored by the Inter-American Tropical Tuna Commission, the Western and Central Pacific Fisheries Commission, and the National Marine Fisheries Service (in the U.S.). The U.S. Western and Central Pacific Ocean purse seine fleet includes 37 vessels, and primarily lands at the port in Pago Pago, American Samoa.
- Recreational fisheries. The recreational fisheries for highly migratory species consist of private vessels and charter vessels using hook-and-line gear. In California, both private boats and a larger charter boat fleet fish for tunas, dorado, billfish and sharks. Albacore tuna are a seasonally important recreational target off of Oregon and Washington.

7.4.3 Recent Fishery Statistics

The total West Coast commercial HMS catch was 12,400 mt in 2010, down 7.2 percent from 2009. Tunas continued to represent 96 percent of the total catch by weight in 2010. Albacore tuna catch was down 3.7 percent from the catch in the previous year, and was by far the largest component of tuna catch, representing 99.7 percent of the total by weight. Bigeye was the next largest component of tuna catch at 31 mt.

Swordfish was the category with the next largest share of landings behind tuna at 3 percent of the total weight. Swordfish landings by weight were down by 10 percent (40 mt) from 2009 to 2010.

Common thresher shark again comprised the largest component of commercial shark landings by weight in 2010. Total commercial shark landings by weight decreased by 19 percent (27 mt) from 2009 to 2010.

Total current dollar West Coast commercial HMS ex-vessel revenue of $32.2 million increased from $30.5 million in the previous year, by 5.7 percent ($1.7 million). Tunas comprised 93 percent of the 2010 revenue total. Albacore generated by far the most important component of revenue for any single species, at $29.6 million. Swordfish was the next highest contributor to total revenue at $2.2 million.

The average price for tuna was 13.4 percent higher in 2010 than in 2009. The overall average West Coast commercial HMS fish price increased from $1.04 in 2009 to $1.18 in 2010, or roughly 14 percent. Prices are not reported for species with fewer than 10 mt of landings, due to potentially large rounding errors.

The principal catch for West Coast recreational private HMS sport fishing fleet are the tunas, with albacore comprising the most important component. Albacore represented by far the largest share overall in 2010 at 53,400 fish. The second most common tuna in that year was yellowfin, with 200 fish caught. The only shark species reported in 2010 were common threshers (700 caught) and mako (400 caught) (PFMC, 2011b).

7.4.4 Domestic Fishery Management

National Marine Fisheries Service (NMFS) partially approved the Fishery Management Plan (FMP) for West Coast highly migratory species fisheries on February 4, 2004. NMFS disapproved provisions that would have allowed targeting swordfish by West Coast longline vessels east of the 150° W. longitude. The FMP is a “framework” plan, which means it includes some fixed elements as well as a process for creating or changing regulations without amending the plan.

The biggest change for fishers stemming from implementation of the FMP is new monitoring requirements, which came into effect on April 11, 2005. As of that date commercial fishers must obtain a permit from NMFS to fish for HMS and maintain logbooks documenting their catch (current state-mandated logbooks meet this requirement). Recreational charter vessels must also keep logbooks. If requested by NMFS, a vessel must carry a fishery observer. These measures are intended to improve data collection about HMS catches.

PFMC’s Highly Migratory Species Management Team prepares a Stock Assessment and Fishery Evaluation (SAFE) Report each year, which provides information about the status of HMS stocks and information about HMS fisheries.

Under the FMP, the Council monitors other species for informational purposes, and some species – including great white sharks, megamouth sharks, basking sharks, Pacific halibut and Pacific salmon – are designated as prohibited. If fishers targeting highly migratory species catch these species, they must release them immediately (PFMC d).

7.4.5 International Fishery Management

Since highly migratory species move throughout large areas of the Pacific and are fished by many nations and gear types, management by the United States alone is not enough to ensure that harvests are sustainable in the long term. The U.S. is a member of the Inter-American Tropical Tuna Commission (IATTC), which is responsible for the conservation and management of fisheries for tunas and other species taken by tuna-fishing vessels in the eastern Pacific Ocean. The U.S. is also a member of the Western and Central Pacific Fisheries Commission (WCPFC), which plays a parallel role in the western and central Pacific (generally, west of 150° W. longitude).

The FMP framework can also provide a mechanism to meet U.S. responsibilities under the United Nations Agreement on the Conservation and Management of Straddling Fish Stocks and High Migratory Fish Stocks (known as the UNIA). The UNIA interprets the duties of nations to cooperate in conserving and managing fisheries resources, and dictates that coastal states may not adopt measures that undermine the effectiveness of regional measures to achieve conservation of the stocks. The U.S. is also a member of the Food and Agriculture Organization of the United Nations (FAO), which has implications for HMS management. In 1995 the FAO's Committee on Fisheries developed a Code of Conduct for Responsible Fisheries, which more than 170 member countries, including the U.S., have adopted. Pursuant to this Code of Conduct, the U.S. has adopted the Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas and four International Plans of Action (IPOAs):

- International Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries
- International Plan of Action for the Conservation and Management of Sharks
- International Plan of Action for the Management of Fishing Capacity
- International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing

In turn, the U.S. has developed national plans of action to carry out the objectives of these international plans. The FMP provides a way to support these national plans of action (PFMC d).

7.5 HALIBUT

7.5.1 Species Description

Pacific halibut (*Hippoglossus stenolepis*) are large flatfish found on the continental shelf from California to the Bering Sea. Halibut have flat, diamond-shaped bodies, can weigh up to 500-700 pounds, and can grow to nine feet long.

Halibut migrate long distances from shallow summer feeding grounds to deeper winter spawning grounds. Halibut eggs float freely and drift in deep ocean currents. They hatch after 12-15 days, and the larvae drift to shallow waters on the continental shelf. Larvae begin life in an upright position with eyes on both sides of their head. When they are about an inch long, the left eye migrates over the snout to the right side of the head, and the color of the left side fades. When the young fish are about six months old, they settle to the sea floor, where the protective coloring on their "eyed" side effectively camouflages them. Female halibut mature at around 12 years, while males mature at around 8 years. Adult fish tend to remain in the same area year after year, except for their migration to deepwater spawning grounds. The oldest halibut on record was 55 years old.

Larval halibut feed on plankton, while adults are carnivorous. Adult halibut prey on cod, pollock, sablefish, rockfish, turbot, sculpins, other flatfish, sand lance, herring, octopus, crabs, clams, and occasionally smaller halibut. Halibut are sometimes eaten by marine mammals, but are rarely preyed upon by other fish (PFMC e).

7.5.2 The Pacific Halibut Fishery

Halibut have been fished for hundreds of years by native Americans on the West Coast of the U.S. The U.S. commercial fishery started in 1888, when halibut were first landed in Tacoma, Washington. Because halibut can be kept for a long time without spoiling, they were a popular target for commercial harvesters.

Halibut are one of the most valuable fish species in the northern Pacific. Longlining is the main commercial gear used to target halibut, although there is some allowance for incidental catch in the commercial salmon troll fishery. In 2002, about 98 million pounds of halibut were removed from the population through directed and incidental catch.

Halibut is also a very popular target for sportfishers. Oregon, Washington, and California have catch limits for recreational halibut fishing, as with commercial and tribal halibut fishing. The demand for halibut sport fishing is so high that closed seasons, bag limits, and possession limits are all used to control the recreational fishery and extend the season as long as possible. Pacific halibut fishing is an important part of several tribal cultures, and many tribal members participate in commercial, ceremonial and subsistence fisheries. In 1995, the U.S. prohibited directed non-treaty commercial fishing north of Pt. Chehalis, Washington in order to allow the tribes to harvest their allocation of halibut (PFMC e).

7.5.3 Recent Fishery Statistics

Commercial halibut catch off the coasts of California, Oregon and Washington was 407,600 pounds in 2010. The recreational catch was estimated at 372,754 pounds.

The International Pacific Halibut Commission (IPHC) issued 565 vessel licenses for this area in 2010. The directed commercial fishery received 192 licenses; the incidental commercial fishery (salmon troll) received 233 licenses, and 140 licenses went to the sport charter fishery (IPHC, 2011).

7.5.4 Halibut Fishery Management

The U.S. West Coast non-Indian commercial directed halibut fishery uses a derby fishery system of 10-hour seasons and fishing period limits. Total catch is set up by the IPHC, but the PFMC allocates portions of the halibut catch to the following user groups:

- Commercial non-Indian
  - Incidental salmon troll
  - Directed longline halibut fishery
  - Incidental longline sablefish fishery
- Sport
- Treaty Indian commercial and ceremonial & subsistence

Each year the IPHC estimates abundance and potential yield of the Pacific halibut stock using commercial fishery data and scientific surveys. The exploitable biomass (the portion of the stock that may be taken) is estimated by fitting a detailed population model to the data from each of three calculation areas. A biological target level for total removals is then calculated by applying a fixed harvest rate (20%) to the estimate for exploitable biomass. The target level for directed setline catches is calculated by subtracting estimates for all other removals – sport catches, bycatch of legal-sized fish, wastage of legal-sized fish in the halibut fishery, and fish taken for personal use. The exploitable biomass for areas other than the three calculation areas is calculated based on relative bottom areas and average catch-per-unit-effort in recent surveys.

The IPHC divides the total allowable catch (TAC) for Oregon, Washington, and California halibut fisheries based on the PFMC's Halibut Catch-Sharing Plan. The Catch-Sharing Plan is modified each year, with final recommendations being made in November. The TAC is set each January by the IPHC. Allocations between some recreational areas are subject to in-season and other changes (PFMC e).

7.6 POTENTIAL EFFECTS OF SEAFOOD WASTE DISCHARGES ON FISHERIES

Commercial and recreational fisheries have the potential to be adversely impacted by seafood waste discharges either directly by the discharged processing wastes or indirectly through effects such as alteration of habitat and increased predation. Potential direct and indirect effects to these fisheries are discussed below.

7.6.1 Potential Effects on Groundfish Fishery

As the name suggests, groundfish are generally demersal for most of their lives. Nevertheless, only a small number of Pacific groundfish species lay demersal eggs. The rest either give birth to live young or lay eggs that are pelagic or epipelagic. The exceptions to this are rock sole, most roundfish, skates, and ratfish (PFMC, 2005b). Smothering of eggs lain by these species could occur due to burial by anoxic decomposing waste piles on the seafloor. Larvae, juveniles, and adults are mobile, so they may be able to avoid waste accumulations.

Seafood wastes that are discharged during spawning and egg production periods have the most potential to adversely affect these species. Nearshore seafood operations have a greater likelihood to adversely impact spawning activities than offshore operations because spawning grounds are more commonly found in these waters, and because waste dispersal is expected to be faster in deeper waters. It is not known at what depth of deposition egg survival would be impaired. However, it is reasonable to conclude that impairment may occur at shallow waste depths, if that depth of waste was sufficient to impair oxygen transfer to the egg or if anoxic conditions were present such as those commonly observed in and around a deposition zone (e.g., Germano & Associates, 2004).

Localized areas of poor water quality (increased turbidity, increased particle suspension, lower dissolved oxygen content) could occur within the action area. In addition to potential direct impacts caused by seafood processing wastes, groundfish could be indirectly affected by seafood processing waste discharge if the abundance and health of invertebrates and other prey species are affected. In particular, the benthic invertebrates on which many species of groundfish feed may suffer the effects of smothering and anoxia caused by waste deposition.

7.6.2 Potential Effects on Salmon Fishery

Salmon lay eggs in fresh water, so there is no danger of suffocation of eggs or larvae due to accumulation of waste on the seafloor.

Important offshore habitat features include water quality, temperature, prey species presence, forage base, and adequate depth (PFMC, 2000). Localized areas of increased turbidity, increased particle suspension, and lower dissolved oxygen content could occur within the action area. In addition to potential direct impacts caused by poor water quality, salmon could potentially be indirectly affected if the abundance and health of their prey is affected by seafood processing waste discharge.

7.6.3 Potential Effects on Coastal Pelagic Species Fishery

The four finfish CPS lay eggs that remain at or near the surface of the ocean. Female market squids, however, attach eggs to the seafloor (PFMC, 1998). As a result, these eggs could be at risk of smothering due to burial by seafood processing waste from offshore seafood processing discharges.

CPS generally live in the pelagic zone, so they are more likely to be affected by water quality changes within the water column than at the bottom. Localized areas of increased turbidity, increased particle suspension, and lower dissolved oxygen content could occur within their habitat. In addition to potential direct impacts caused by poor water quality, CPS could be indirectly affected if the abundance and health of plankton and other food sources are affected by seafood processing waste discharges.

7.6.4 Potential Effects on Highly Migratory Species Fishery

No HMS lay demersal eggs, so potential burial or suffocation of eggs, by seafood processing waste, is unlikely.

Localized areas of increased turbidity, increased particle suspension, and lower dissolved oxygen content could occur within the action area. In addition to potential direct impacts caused by poor water quality, these HMS could be indirectly affected if the abundance and health of their prey is affected by seafood processing waste discharges.

7.6.5 Potential Effects on Halibut Fishery

Halibut eggs float, so potential burial or suffocation of eggs is unlikely.

Localized areas of increased turbidity, increased particle suspension, and lower dissolved oxygen content could occur within the action area. In addition to potential direct impacts caused by poor water quality, halibut could be indirectly affected if the abundance and health of their prey is affected by seafood processing waste discharges.

7.7 SUMMARY

Waters within the action area of the Draft Permit sustain several commercially important fisheries. Washington and Oregon residents as well as non-residents also participate recreationally within the fisheries. Major fisheries exist for groundfish, salmon, coastal pelagic species and highly migratory species.

Localized areas of increased turbidity, increased particle suspension, seafood waste accumulation, and lower dissolved oxygen content could occur within the action area and could negatively affect all of the fisheries. In addition to potential direct impacts caused by poor water quality, the fisheries could be indirectly affected if the abundance and health of their prey is affected by seafood processing waste discharges. It is anticipated that restrictions included in the Draft Permit will diminish these types of potential impacts. Impacts due to seafood processing waste are limited to the immediate vicinity of the discharge, and the receiving waters are sufficiently oxygenated and well-mixed to allow for dispersion and dilution of pollutants.

SECTION 8.0

COASTAL ZONE MANAGEMENT AND SPECIAL AQUATIC SITES

The determination of “unreasonable degradation” of the marine environment is to be made based upon consideration of the ten criteria listed in Section 1.0. The following section provides information pertinent to consideration of the two criteria shown below:

Criterion #8: “Any applicable requirements of an approved Coastal Zone Management plan”

Criterion #5: "The existence of special aquatic sites including, but not limited to marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs"

8.1 COASTAL ZONE MANAGEMENT

According to Section 304 (Definitions) of the Coastal Zone Management Act (16 U.S.C § 1453), the coastal zone extends seaward to the outer limit of State title and ownership. This Draft Permit only applies to discharges in federal waters, greater than 3 nm from the shore. Therefore, state coastal zone management plans (or other state regulations) need not be evaluated.

8.2 SPECIAL AQUATIC SITES

8.2.1 Olympic Coast National Marine Sanctuary

The National Marine Sanctuaries Act (NMSA) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance as national marine sanctuaries. Day-to-day management of these areas has been delegated to the National Oceanic and Atmospheric Association (NOAA)'s Office of National Marine Sanctuaries. The primary objective of the NMSA is to protect marine resources, such as coral reefs, sunken historical vessels or unique habitats.

The Olympic Coast National Marine Sanctuary (OCNMS), designated on May 11, 1994 (59 FR 24586), consists of an area of approximately 2,408 square nm of coastal and ocean waters, and the submerged lands thereunder, off the central and northern coast of the State of Washington. The sanctuary extends 25 to 50 miles seaward, covering much of the continental shelf and several major submarine canyons. The sanctuary protects a productive upwelling zone - home to marine mammals and seabirds. Along its shores are thriving kelp and intertidal communities, teeming with fishes and other sea life. In the darkness of the seafloor, scattered communities of deep sea coral and sponges form habitats for fish and other important marine wildlife.

Specific boundaries and regulations pertaining to the OCNMS are found in Subpart O of 15 CFR Part 922. The Sanctuary location is shown in Figure 8.1. Section 922.152(a)(2) prohibits:

(i) Discharging or depositing, from within or into the Sanctuary, other than from a cruise ship, any material or other matter except:

- (A) Fish, fish parts, chumming materials or bait used in or resulting from lawful fishing operations in the Sanctuary;
- (B) Biodegradable effluent incidental to vessel use and generated by marine sanitation devices approved in accordance with section 312 of the Federal Water Pollution Control Act, as amended, (FWPCA), also known as the CWA, 33 U.S.C. 1322 et seq.;
- (C) Water generated by routine vessel operations (e.g., cooling water, deck wash down, and graywater as defined by section 312 of the FWPCA) excluding oily wastes from bilge pumping;
- (D) Engine exhaust; or
- (E) Dredge spoil in connection with beach nourishment projects related to the Quillayute River Navigation Project.

(ii) Discharging or depositing, from beyond the boundary of the Sanctuary, any material or other matter, except those listed in paragraphs (a)(2)(i)(A) through (E) of this section, that subsequently enters the Sanctuary and injures a Sanctuary resource or quality.

This description indicates that waste discharges associated with offshore seafood processing vessels are not prohibited within the OCNMS. Therefore, no additional restrictions beyond the Draft Permit requirements need be implemented in this area.

8.2.2 Areas Closed to Fishing

According to 50 CFR 660.131(c), vessels fishing in the Pacific whiting primary seasons shall not target Pacific whiting with midwater trawl gear in the Columbia River salmon conservation zone. As shown in Figure 8.1, this closed area is defined as the ocean area surrounding the Columbia River mouth bounded by a line extending for 6 nm due west from North Head along 46°18′ N. lat. to 124°13.30′ W. long., then southerly along a line of 167 True to 46°11.10′ N. lat. and 124°11′ W. long. (Columbia River Buoy), then northeast along Red Buoy Line to the tip of the south jetty.

In addition, when NMFS projects the Pacific whiting fishery may take in excess of 11,000 Chinook within a calendar year, the Ocean salmon conservation zone will automatically be closed to whiting fishing with midwater trawl gear. This area, shown in Figure 8.1, includes all waters shoreward of a boundary line approximating the 100 fm (183 m) depth contour. Latitude and longitude coordinates defining the boundary line approximating the 100 fm (183 m) depth contour are provided at 50 CFR § 660.73, subpart C.

These restrictions are only for the act of fishing and do not limit processing that may be going on in the area. According to 50 CFR 660.131(g), a vessel that processes only fish waste (a "waste-processing vessel") is not considered a whiting processor and therefore is not subject to the allocations, seasons, or restrictions for catcher/processors or motherships while it operates as a waste-processing vessel. Therefore, no section of the action area will be closed to seafood processing in the Draft Permit.

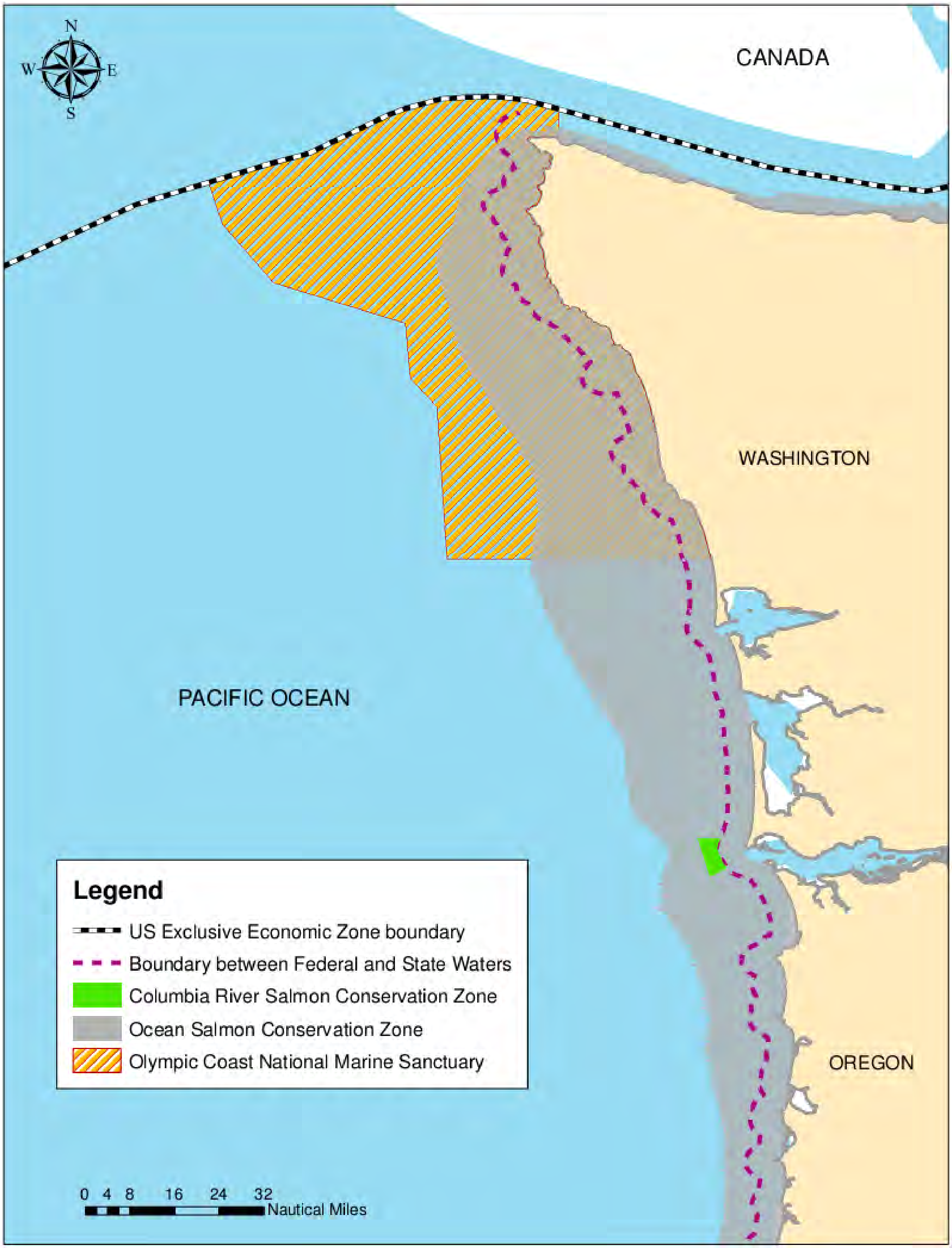

Figure 8.1 Special Aquatic Areas

SECTION 9.0
MARINE WATER QUALITY

The determination of "unreasonable degradation" of the marine environment is to be based on consideration of the ten criteria listed in Section 1.0. The following section provides information pertinent for the consideration of the ocean discharge criterion listed below:

Criterion #10: "Marine water quality criteria developed pursuant to Section 304(a)(I)."

9.1 INTRODUCTION

The water quality criteria are the foundation of the water quality-based control program mandated by the CWA. Under section 304(a), the EPA publishes water quality criteria that consist of scientific information regarding concentrations of specific chemicals or levels of parameters in water that protect aquatic life and human health. Water quality criteria are set to protect each designated use and are based only on data and scientific judgments about pollutant concentrations and their effects. Whether numeric or narrative in form, water quality criteria protect waterbody uses by describing the chemical, physical and biological conditions necessary for safe use of waters by humans and aquatic life.

The primary pollutants of concern for water quality impacts from offshore seafood facilities result from the discharge of soluble and suspended solid wastes. Both soluble and suspended solid wastes include organic matter and nutrients with the potential to reduce light penetration, reduce dissolved oxygen levels of the receiving water, enhance the growth of algae and phytoplankton, and alter phytoplankton species composition. Chlorine and other disinfectant wastes are an additional concern when these products are used to sanitize seafood processing work areas and are then discharged without treatment to the receiving water.

In this section the potential pollutant discharges resulting from seafood processing operations are discussed in terms of its compliance with federal marine water quality criteria. The marine water quality criteria that are relevant to the evaluation of potential adverse impacts of seafood processing waste include:

- Settleable and Suspended Solids
- Oil and grease
- Aesthetics
- Color
- Toxic substances including residual chlorine, unionized ammonia, and undissociated hydrogen sulfide
- pH

The application of these criteria is described below.

9.2 SETTLEABLE AND SUSPENDED SOLIDS

For the aquatic life, the criterion for settleable and suspended solids is as follows:

"Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent."

As demonstrated in Section 3.0, solids concentration in the receiving water should be less than 9.79 mg/l. Violations of the settleable and suspended solids criteria for the compensation point for photosynthetic activity will depend on the ambient conditions at each discharge location, but will be unlikely. As such, the water quality criterion for settleable and suspended solids currently is incorporated as an adherence in the Draft Permit under effluent limitations and requirements.

9.3 OIL AND GREASE

Oil and grease is regulated by a narrative criteria depending on the designated use of the water. The criteria that applies to the action area include:

- Levels of oils or petrochemicals in the sediment which cause deleterious effects to the biota shall be prevented.
- Surface waters shall be virtually free from floating nonpetroleum oils of vegetable or animal origin, as well as petroleum-derived oils.

The Draft Permit also includes the following prohibition:

The discharge of petroleum (e.g., diesel, kerosene, and gasoline) or hazardous substances into or upon the navigable waters of the U.S., adjoining shorelines, into or upon the waters of the contiguous zone which may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the U.S., is prohibited under 33 U.S.C. 1321(b)(3)

The primary water quality concern from seafood processing waste is floating oils derived from fish fats and discharged as waste. These discharges are also covered under the aesthetics criteria below. Many vessels recover the oil from the fish they process either to use as a sellable product or to use onboard, as a fuel source. Violations of the oil and grease criteria are unlikely. The water quality criterion for oil and grease is currently incorporated as an adherence under effluent limitations and requirements.

9.4 AESTHETICS

Aesthetics are regulated by the following narrative criteria:
All receiving waters shall be free from substances attributable to wastewater or other discharges that:

- settle to form objectionable deposits;
- float as debris, scum, oil, or other matter to form nuisances;
- produce objectionable color, odor, taste, or turbidity;
- injure or are toxic or produce adverse physiological responses in humans, animals or plants; and,
- produce undesirable or nuisance aquatic life.

The water quality concern is the creation of floating oil sheens derived from fish and shellfish fats and oils that are discharged as wastes. As with foam and floating material, the presence of floating oil sheen will depend on the physical and chemical characteristics of the discharged wastewater and the receiving water. Another water quality concern is the accumulation of waste on the seafloor or creation of waste piles. As demonstrated in section 3.0, there should not be a large accumulation of seafood processing waste on the seafloor. The very conservative, worst case scenario predicted an average solids deposit of 0.5 cm. It is believed that very little if any waste will reach or be accumulated on the seafloor.

The water quality criterion for aesthetics is incorporated in the Draft Permit under effluent limitations and requirements.

9.5 COLOR

Color is regulated by the following numeric and narrative criteria:

Waters shall be virtually free from substances producing objectionable color for aesthetic purposes and increased color (in combination with turbidity) should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.

Color from seafood processing waste is mainly associated with the blood of the fish. With the high dilutions discussed in section 3.0, it is anticipated that the criterion for color will not be violated. The water quality criterion for color is incorporated in the Draft Permit under effluent limitations and requirements.

9.6 DISSOLVED OXYGEN

Hypoxia, a low concentration of dissolved oxygen, is increasing in coastal waters worldwide. The Oregon continental shelf is the site of the second largest hypoxic zone in the United States. Although coastal hypoxia can be caused by natural processes, a dramatic increase in the number of U.S. waters exhibiting hypoxia is linked to eutrophication due to nutrient (nitrogen and phosphorus) and organic matter enrichment resulting from human activities (CENR, 2010).

CWA § 304(a) criteria does not exist for dissolved oxygen within the action area, therefore, nearby state water quality standards were evaluated. The States of Washington and Oregon have a numeric dissolved oxygen criteria of 7.0 mg/l as the lowest 1-day minimum (WA) or with no measurable reduction in dissolved oxygen concentration allowed (OR). Dissolved oxygen concentrations at the surface of marine waters are typically greater than 7.0-8.0 mg/L. Permitted discharges of seafood processing waste to oxygenated well-flushed areas and consistent with Draft Permit limitations are not expected to cause a reduction of dissolved oxygen sufficient to have an adverse effect on marine organisms.

9.7 TOXICS AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES

The toxic pollutants of concern for seafood processing waste include residual chlorine, unionized ammonia, and undissociated hydrogen sulfide.

9.7.1 Total Residual Chlorine

Disinfectants, including chlorine-based products, are used in the seafood processing industry to destroy potential disease-causing microorganisms that could contaminate finished seafood products destined for human consumption. The Food and Drug Administration (FDA) regulations mandate frequent cleaning (through the use of alkaline detergents) and disinfection (through the use of hypochlorites, iodophors, and quaternary ammonium compounds) of seafood processing utensils, equipment, and processing areas to minimize microbiological contamination of seafood products (21 CFR 123). Associated with the benefits of disinfection, however, are potential adverse effects associated with the reaction of chlorine and chlorine compounds with organic matter and ammonia in the wastewater. Disinfectant reaction byproducts include potentially carcinogenic chlorinated organic compounds and toxic forms of chlorinated ammonia and chloroamines. In freshwater, chlorine reacts with water to form hypchlorous acid, hypochlorite ion, and other reactive forms that include mono- and dichloroamines. These reactive forms are termed “residual chlorine”. In seawater, chlorine also reacts with bromide to form hypobromous acid, hypobromite ion, and bromamines. Therefore, the term “chlorine-produced oxidants” is used to refer to the residual chlorine forms measured in seawater.

The chronic marine water quality criterion for total residual chlorine is 7.5 µg/L.

Because of the complexity of chlorine reactions in marine waters (Johnson 1980), it is difficult to assess the potential adverse effects of the intermittent application of disinfectants to seafood processing areas. No data are available on the typical amounts and rates of application of active disinfectant ingredients in a typical seafood processing facility. However, it is assumed that residual chlorine concentrations in the effluent discharged to the receiving water is low considering the following:

- The equipment to be disinfected is first washed to remove much of the visible organic residue and contamination to minimize the quantity of disinfectant required. The disinfectants are applied in diluted form only to the areas to be disinfected.
- The process wastewater effectively dilutes residual disinfectant concentrations.
- The residual chlorine compounds remaining after equipment disinfection are reduced when they contact the high concentration of readily oxidized organic waste matter in the wastestream.

The Draft Permit requires permittees to evaluate potential pollutants based on the hazards they present to human health and the environment. This includes minimizing toxic disinfection use where applicable, as disinfectants are known to be toxic to marine organisms at relatively low concentrations.

9.7.2 Unionized Ammonia

Unionized ammonia can be toxic to marine organisms. The concentration of unionized ammonia depends on the total ammonia concentration and the salinity, temperature, and pH of the water. A relatively conservative estimate of the chronic criterion for total ammonia for the action are, based on a salinity of 30 parts per thousand (ppt), pH of 8.2, and water temperature of 15°C, is 1.0 mg N/L.

Sources of ammonia attributable to seafood processing discharges include ammonia dissolved in the seafood processing wastewater, ammonia used in refrigerants, and ammonia released from the decaying waste organic matter in the water column or from seafood waste that has accumulated on the bottom.

Review of historical water quality studies conducted in confined bays in the vicinity of active Alaskan seafood processing discharges (Tetra Tech 1986) indicates that maximum water column total ammonia concentrations did not exceed 0.75 mg/L. Other data are not available.

The historical data, however, remain valid because ammonia use has not changed in the industry over the past 20 years.

9.7.3 Undissociated Hydrogen Sulfide

The saltwater chronic criterion for undissociated hydrogen sulfide is 2.0 µg/L. Hydrogen sulfide (H_2S) is produced by the anaerobic decay of organic matter by bacteria that use sulfate as an electron acceptor. In studies conducted in Alaskan marine waters, most of the hydrogen sulfide (approximately 97.5 percent) dissociates to HS^- and H^+ (Tetra Tech 1987; Goldhaber and Kaplan 1975). The remaining undissociated sulfide (approximately 2.5 percent) can be toxic to marine organisms.

Because hydrogen sulfide in marine water occurs primarily in the dissociated form, and because hydrogen sulfide is also rapidly oxidized to sulfate in sea water (Almgren and Hagstrom 1974), undissociated hydrogen sulfide concentrations above seafood waste piles are expected to be below water quality criteria, except possibly just above the waste pile (Tetra Tech 1987). As demonstrated in section 3.0, large amounts of waste accumulation on the seafloor is unlikely, therefore, violations of the water quality criteria are not anticipated.

9.8 pH

The current national saltwater pH range recommended for the protection of aquatic life is 6.5-8.5 standard units. Some of the wastewater associated with seafood processing wastes can be slightly alkaline or acidic but is generally within the range of the water quality criteria. This is evidenced by monitoring data from individual permits between 2002 and 2005, which show most values within the 6.5-8.5 range.

Over the past few years there has been a growing awareness of ocean acidification, which is the decrease in ocean pH caused by the increased uptake of carbon dioxide (CO_2) from the atmosphere. Since the beginning of the industrial era in the 1800s, the pH of open-ocean surface waters has decreased by about 0.1 pH units from 8.2 to 8.1, which represents an overall increase of about 30% in the hydrogen ion concentration, and it is projected to decline by another 0.3–0.4 pH units by the end of this century (Feely et al., 2012).

Acidification has an adverse impact on the health of many marine species. The waters offshore of Washington and Oregon are particularly vulnerable to pH decline due to regional ecosystem drivers (Feely et al., 2012). Washington became the first state in the nation to address ocean acidification with the convening of a blue ribbon panel on the topic in February 2012 and the resulting report. In addition, the U.S. EPA took comments on whether and how to address ocean acidification under the CWA, which could ultimately lead to the regulation of activities that decrease ocean pH (75 FR 13537).

At this time there have been no changes made to state or federal laws to address this water quality issue, so this document can only base its assessment on current regulations. Given the general pH range of seafood processing waste as well as the relatively small volume of waste generated with respect to the volume of the receiving waters, the discharge is not expected to have a significant impact on the pH of the ocean offshore of Washington and Oregon.

9.9 SUMMARY

If operators comply with the limitations and requirements of the Draft Permit, exceedances of water quality criteria should be prevented.

SECTION 10.0

DETERMINATION OF UNREASONABLE DEGRADATION

Section 1.0 of this ODCE provides the regulatory definition of unreasonable degradation of the marine environment (40 CFR 125.121[e]) and indicates the ten criteria which are to be considered when making this determination (40 CFR 125.122). The actual determination of whether the discharge will cause unreasonable degradation is made by the USEPA Regional Administrator. Section 10.1 briefly summarizes information pertinent to the determination of unreasonable degradation with respect to the ten criteria. Section 10.2 provides recommendations to avoid unreasonable degradation of the marine environment.

10.1 DETERMINATION CRITERIA

10.1.1 Criterion 1

The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged.

As demonstrated by the numerical analysis in Section 3.0 that use conservative estimates for conditions and inputs (e.g., daily waste discharge), accumulation of waste on the seafloor is highly unlikely. Seafood processing wastes are not expected to contain pollutants that may bioaccumulate in aquatic organisms or humans, and therefore are not expected to pose a long-term threat to the health of aquatic organisms or humans.

10.1.2 Criterion 2

The potential transport of such pollutants by biological, physical, or chemical processes.

Mobile offshore seafood processors are located in areas of high tidal activity which allows for dispersion and dilution of ground organic wastes and minimizes the potential for accumulation of settleable solids. The fact that processor vessels are in constant motion while processing further enhances the potential for dilution. Soluble waste authorized under the Draft Permit are expected to be rapidly diluted or degraded by biological, physical, and chemical processes.

10.1.3 Criterion 3

The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the ESA, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain.

Small pelagic organisms which drift in ocean currents, such as fish larvae, fish eggs, and plankton, could be directly impacted by components present in seafood processing waste discharges. Disinfectants in the waste stream could be toxic to them. Suspended particles could stress feeding and respiratory processes. Excess nutrients and changes in water column light penetration could lead to shifts in relative abundance and ecosystem structure. Potential indirect impacts include a reduction in dissolved oxygen content and/or the release of potentially toxic decay byproducts. Any of these changes could lead to direct mortality as well as reduced efficiency of physiological processes such as food processing and growth. As these organisms form the base of the marine food chain, negative impacts on their health and abundance would likely adversely affect the animals which rely on them as food. The numerical analysis in Section 3.0 indicates that compensation depth is unlikely to be significantly impacted by suspended solids from seafood processing waste; therefore, photosynthetic activity by phytoplankton is not expected to be affected.

Benthic communities in the area of seafood waste discharges could be smothered due to burial by waste piles or by anoxic conditions or changes in sediment chemistry due to decay of the accumulated wastes. The numerical analysis in Section 3 suggests that waste piles are unlikely to accumulate, so physical smothering is not anticipated. Discharges of seafood processing waste to oxygenated well-flushed waters consistent with Draft Permit limitations are not expected to cause reduction of dissolved oxygen sufficient to have an adverse effect on marine organisms.

There are eight marine mammals, ten fish species, two birds, and four sea turtles which may be found within the Draft Permit action area, that are currently listed as threatened or endangered pursuant to the Endangered Species Act. Most marine mammals, fish, and turtles are highly mobile and, therefore, able to swim out of harm's way. The exception to this is rockfish and eulachon larvae.

Species that are attracted to waste as a food source may be at increased risk of harm from predation or ship strikes. The Draft Permit prohibits substances to be discharged that float as debris, scum, oil, or other matter to form nuisances. The Draft Permit also requires that the discharge of seafood processing wastes must not create an attractive nuisance situation whereby fish or wildlife are attracted to waste disposal or storage areas in a manner that creates a threat to fish or wildlife or to human health and safety.

Assuming seafood processing waste is discharged in compliance with Draft Permit limitations and requirements, then impacts to receiving waters should be localized; therefore, effects on overall marine habitat and biological communities are likely to be minor.

10.1.4 Criterion 4

The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.

The U.S. EEZ off the coast of Washington and Oregon is important for a variety of species, ranging from phytoplankton to marine mammals. Marine mammals, fish, sea turtles, and sea birds use this area for migration and feeding. All of these are impacted by the health and abundance of communities of phytoplankton, zooplankton, and other prey species. Cetaceans and some fish also reproduce in the open ocean.

Two critical habitat areas for ESA listed species intersect with large portions of the Draft Permit action area. Critical habitat for the endangered leatherback sea turtle includes 25,004 square miles (64,760 square km) from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour, including waters from the ocean surface down to a maximum depth of 262 feet (80 m). Critical habitat for the threatened North American green sturgeon includes all U.S. coastal marine waters out to the 60 fm (110 m) depth bathymetry line (relative to MLLW) from Monterey Bay, California north and east to include waters in the Strait of Juan de Fuca, Washington.

The Draft Permit prohibits the occurrence of substances that float as debris, scum, oil, or other matter to form nuisances on the sea surface and thereby eliminate potential impact of oil on species foraging on the waste. Since, seafood processing wastes are discharged in high tidal activity areas which allows for adequate dispersion and dilution, and impacts to receiving waters are localized, effects on habitat and the receiving water are likely to be minor.

10.1.5 Criterion 5

The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs.

There is one National Marine Sanctuary, Olympic Coast NMS, that intersects with the Draft Permit action area. No special restrictions on fishing are known to exist in this Sanctuary.

There are two Salmon Conservation Zones (SCZ) that intersect with the Draft Permit action area. The Columbia River SCZ is closed to Pacific whiting fishing with mid-water trawl gear in whiting primary seasons. The Ocean SCZ is closed to whiting fishing with mid-water trawl gear when the NMFS projects the Pacific whiting fishery may take in excess of 11,000 Chinook within a calendar year.

These restrictions are only for the act of fishing and do not limit seafood processing that may be going on in the area. According to 50 CFR 660.131(g), “a vessel that processes only fish waste (a “waste-processing vessel”) is not considered a whiting processor and therefore is not subject to the allocations, seasons, or restrictions for catcher/processors or motherships while it operates as a waste-processing vessel.” Therefore, no section of the action area will be closed to seafood processing in the Draft Permit.

Because the Draft Permit action area is entirely within federal waters, no state marine protected areas have been included.

10.1.6 Criterion 6

The potential impacts on human health through direct and indirect pathways.

Seafood processing waste discharges are not expected to result in impacts to human health. These discharges are not thought to contain pollutants that bioaccumulate in aquatic organisms; therefore they are not expected to result in elevated levels of toxic or carcinogenic pollutants in marine organisms consumed by humans.

10.1.7 Criterion 7

Existing or potential recreational and commercial fishing, including finfishing and shellfishing.

The U.S. EEZ off the coast of Washington and Oregon sustains several important fisheries for species including groundfish, salmon, coastal pelagic species, highly migratory species, and halibut. These fisheries have commercial, recreational, and tribal harvest components. Seafood waste discharges have the potential to adversely impact the health of the fishery populations both directly and indirectly.

Seafood wastes that are discharged during spawning and egg production periods have the most potential to directly adversely affect fish. Near-shore discharges are more likely to have a negative impact than discharges in the open ocean because spawning grounds are more commonly found in shallower waters, and because waste dispersal is expected to be faster in deeper, more energetic waters. Discharges authorized under the Draft Permit are to offshore waters with good flushing, reducing the potential for adverse effects.

Discharges may cause direct harm by habitat alteration throughout the water column. On the seafloor, accumulated waste that restricts oxygen, could bury and smother demersal eggs of squid and several groundfish species. This decomposing waste could also alter parts of the benthic habitat in which many groundfish live. Larvae, juveniles, and adults are mobile, so they may be able to avoid these areas. Many groundfish could also be indirectly affected by the loss of benthic food sources due to waste piles. However, the analysis reported in Section 3.0 demonstrates that accumulation of waste piles is not likely to occur in the Draft Permit action area.

In the pelagic zone, localized areas of short-term increased turbidity, increased particle suspension, and lower dissolved oxygen content could occur. In addition to potential direct impacts caused by short-term effects on water quality, fish could be indirectly affected if the abundance and health of plankton and other food sources are affected. However, the analysis in Section 3.0 demonstrates that TSS in the water column will be minimal which should ensure dissolved oxygen levels are not depleted, reducing potential adverse effects on the growth of plankton and food sources.

Increased predation may occur, particularly of larvae and juveniles, due to the attraction of fish and waterfowl to the discharges. However, the Draft Permit contains the narrative standard that, the discharge of seafood processing wastes must not create an attractive nuisance situation whereby fish or wildlife are attracted to waste disposal or storage areas in a manner that creates a threat to fish or wildlife or to human health and safety.

10.1.8 Criterion 8

Any applicable requirements of an approved Coastal Zone Management Plan

Because the Draft Permit action area is entirely within the U.S. Exclusive Economic Zone, it is not under the jurisdiction of state Coastal Zone Management Plans, which only extend to the 3 nautical mile boundary of state waters.

10.1.9 Criterion 9

Such other factors relating to the effects of the discharge as may be appropriate.

Concerns have been raised about potential indirect effects of the discharge of seafood processing waste on marine organisms. These indirect effects include the following:

- Nutrient enrichment of marine waters may result in enhanced biomass of phytoplankton and/or alteration of plankton species composition. Toxic phytoplankton species may occur more frequently and at higher levels under these conditions resulting in adverse effects to aquatic organisms, and potentially to human health.
- The attraction of certain species to waste discharges which makes them easier prey for predators.
- The attraction of seabirds to waste discharges which may result in a number of adverse effects that range from oiling, and enhancement of the numbers of gulls that may disturb threatened or endangered species.

These concerns should be minimal due to the fact that mobile offshore seafood processors will be located in areas of high tidal activity allowing for dilution and dispersion of seafood waste discharges. Permitted discharges of seafood waste to oxygenated well-flushed areas consistent with Draft Permit limitations and requirements are not expected to cause reduction of dissolved oxygen sufficient to have an adverse effect on marine organisms. The Draft Permit prohibits discharges that float as debris, scum, oil, or other matter to form nuisances and thereby eliminate potential impact of oil on birds foraging on the waste.

10.1.10 Criterion 10

Marine water quality developed pursuant to Section 304(a) of the CWA.

The regulated discharge of seafood processing waste is expected to comply with relevant marine water quality criteria.

10.2 CONCLUSIONS

The EPA has evaluated the discharges authorized under the Draft Permit against the ocean discharge criteria at 40 CFR 125.122. Based on this evaluation, EPA concludes that the discharges will not cause unreasonable degradation of the marine environment under the conditions, limitations and requirements established by the Draft Permit.

SECTION 11.0
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